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BRASNETT (N. V.). **The Growing of Mvule in Uganda.**—*E. Afr. agric. J.* **10** no. 2 pp. 83–89, 8 refs. Nairobi, 1944.

The author describes attempts that have been made in Uganda since 1908 to establish plantations of mvule (*Chlorophora excelsa*), one of the most important timbers in the Protectorate, and the work carried out since 1930 to control its natural enemies, which include a number of mammals and *Phytolyma lata*, Wlk. [*cf. R.A.E.*, A **24** 650]. This gall-forming Psyllid was found to be most active and numerous about five or six weeks after the main rainy season, when the plants are normally growing rapidly. The eggs are laid chiefly on the soft tissue at the base of leading and terminal buds ; one coppice shoot was observed to grow five inches in the 21 days between oviposition and adult emergence, so that the gall was well below the growing point, and this probably explains why less damage is done to vigorously growing plants than to unhealthy ones, although the former have far more galls on them because of the greater amount of young tissue produced. In Busoga, treatment of part of a nursery bed with lime had no apparent effect on growth or resistance to attack by the Psyllid. On one plantation, patrols were employed to tend every plant by hand once a week, observations having shown that the shortest time after oviposition at which a gall could be detected was three days, when the gall is very small and can be rubbed off with the finger, but is very easy to miss ; nine days after oviposition it is very obvious, but can still be slit open with a razor-blade without damaging the normal plant tissue, thereby preventing further development of the insect, which if undisturbed would emerge in another 12 days. Cutting off galls in such a way as to cause considerable exudation of sap was found to be harmful. The leading shoots can only be treated easily when they are not more than 9–10 ft. above the ground and can be bent over for inspection, but the Psyllid appears to remain fairly near the ground, and after this height is reached, the leading shoot is protected by the leaves and branches to a certain extent. In spite of treatment, the trees failed to make satisfactory growth, and the plantation was abandoned. Further attempts to plant with large stumps, which made rapid growth for the first few years, were also unsuccessful, and soil analyses indicated that natural regeneration of *C. excelsa* occurred only where the soil was slightly alkaline ; it was concluded that old house sites and termite mounds caused a local increase of bases in the soil and that the tree would thrive only on such accumulations in this region. Similar attempts were made in other areas, in some of which the Psyllid was not at first present. However, it soon appeared, though it was more heavily parasitised than in Busoga ; the parasites were the Encyrtid, *Psyllaephagus phytolymae*, Ferrière, which was the most numerous, and two Tetrastichine Eulophids ; the West African parasite, *Aprostocetus roseveari*, Ferrière [*cf.* **19** 378 ; **29** 492] has not been recorded from Uganda. On one estate originally planted with *Hevea* rubber and later underplanted with coffee, *Chlorophora* trees planted in 1920 were severely infested by the Psyllid in the early stages, but outgrew the attack without treatment of any kind. The estate was abandoned, and in 1935 eleven well-grown trees were found near a stream, confirming the ability of this plant to withstand attack under suitable conditions.

It is concluded that *P. lata* is not an insuperable obstacle to the cultivation of *C. excelsa*, that hand-tending is helpful in regular plantings and that even if it is impracticable, a fair proportion of the trees will, under favourable conditions, slowly outgrow the stage of susceptibility.

HANSFORD (C. G.). **A probable Virus Disease of Sweet Potato.**—*E. Afr. agric. J.* **10** no. 2 pp. 126–127. Nairobi, 1944.

In March 1944, native varieties of sweet potato growing at Kawanda were observed to be affected by a disease that was considered to be due to a virus.

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Reports indicate that it is widely distributed in Uganda, is present in the Ruanda and Urundi districts of the Belgian Congo and in the adjoining parts of Tanganyika, and is very injurious in the area west of Lake Albert. The symptoms are described. The disease spreads from infected to healthy plants under field conditions, and an insect vector is almost certainly concerned. Large numbers of Aleurodids were observed in affected plots, and these may be the vectors; they have not yet been identified, but appear to be closely related to the species of *Bemisia* known to transmit the virus [*Ruga bemisiae* of Holmes] that causes mosaic disease of cassava [*cf. R.A.E.*, A **28** 143, etc.]. No previous records of such an insect on sweet potato have been made in Uganda; and this may indicate that it is a new pest of this crop, possibly favoured by a succession of dry years.

Identification of the disease in the field is complicated by the attacks of species of *Cylas*, which cause dwarfing and yellowing by boring in the base of the vines. Plants showing the infection appear to be more liable to attack by these weevils than healthy ones, possibly on account of their much slower growth. When portions of such plants free from weevils were planted in the greenhouse, they reproduced the virus symptoms of their parents, so that there is no doubt that the two are independent.

HINTON (H. E.). **A Monograph of the Beetles associated with stored Products. Volume I.**—10 × 7½ ins., 443 pp., 505 figs., 26½ pp. refs. London, Brit. Mus. (Nat. Hist.), 1945. Price 30*s*.

In this first volume of a work on the taxonomy of beetles associated with stored products, the author gives keys to the adults of 39 and the larvae of 37 families, and deals in detail with the Carabids, Staphylinids, Nitidulids, Lathridiids, Mycetophagids, Colydiids, Murmidiids, Endomychids, Erotylids, Anthicids, Cryptophagids and Dermestids. For each family, a general account of the bionomics or habits, the general characters of the adults and, in most cases, of the larvae, and keys to the adults and, where material was available, to the larvae and pupae of the various species are given, together, in the case of the more important families, with a discussion of their economic importance. Information on the individual species includes descriptions or distinguishing characters, or both, of the adults and sometimes of the larvae and summaries of the synonymy, distribution and habits. Most of the information in the chapter on Lathridiids has already been published elsewhere [*cf. R.A.E.*, A **30** 295].

Of the species to which reference has been made in this *Review*, *Carpophilus aterrimus*, Macleay, is regarded as a synonym of *C. hemipterus*, L., *C. decipiens*, Horn, of *C. ligneus*, Murray, and *Eucnocerus anthrenoides*, Sharp, of *Trogoderma ornatum*, Say. *Anthicus troilus*, n. n., is proposed for *A. elegans*, Lea, which is preoccupied.

[USHATINSKAYA (R. S.).] **Ушатинская (Р. С.). The Influence of Temperature and Humidity on the Formation of the Hypopi of *Glycyphagus destructor* Schrk.** [*In Russian.*]—*Zool. Zh.* **24** no. 3 pp. 165–174, 1 graph, 13 refs. Moscow, 1945. (With a Summary in English.)

To supplement studies by Polezhaev on the effect of medium temperatures on the production of hypopi by *Glycyphagus destructor*, Schr. [*cf. R.A.E.*, A **31** 72], laboratory investigations, the technique of which is described, were carried out in 1940 to ascertain the effect on this process of temperatures of 0–10°C. [32–50°F.] and 25–40°C. [77–104°F.], within which the lower and upper limits of activity of the mite occur. The relative humidity was maintained at 85–90 per cent. and the initial moisture content of the wheat in which the mites were kept was 14·4–14·8 per cent. in the experiments at the lower temperatures and 16·2 per cent. in those at the higher ones.

No hypopi appeared at 0°C. and very few at 5°C. [41°F.]. At 10°C., the mite population rapidly increased, and the percentage of hypopi was 1·8 after 78 days and 29·1 after 200 days. Except a very few at 10°C., the hypopi did not transform into second stage nymphs until the temperature rose above 12°C. [53·6°F.]. The hypopi therefore accumulate at low temperatures, and this gives rise to the erroneous impression that such temperatures stimulate their appearance. If after long exposure to temperatures of the order of 6–19°C. [42·8–66·2°F.], such as occur in basements in Russia, the temperature drops to 0°C. or lower, the active stages of the mite, which are not resistant to cold, die out, and only the hypopi, which can withstand low temperatures for months, remain.

High temperatures also did not stimulate the production of hypopi. At 25 and 30°C. [86°F.] the percentages of hypopi while the moisture content of the grain was still above 14 per cent. did not exceed 0·5 and these transformed normally into second-stage nymphs, but as the grain became drier the active stages died out and only the hypopi remained. When transferred to a temperature of 22°C. [71·6°F.] and a relative humidity of 90 per cent., the hypopi obtained at 25°C. transformed into second-stage nymphs and developed normally, but all those obtained at 30°C. died. At 34·5 [94·1°F.] and 40°C., the mobile stages died out completely in six and two days, respectively, and no hypopi appeared, but hypopi obtained under other conditions survived exposure to 40°C. for 9 days.

In experiments at 15–22°C. [59–71·6°F.], no hypopi appeared if the moisture content of the grains was below 13·2 or above 17·2 per cent. (corresponding to relative atmospheric humidities of 57–58 and 83–84 per cent.). Within this range, the mites increased with the moisture content of the grain, and as the hypopi readily transformed into second-stage nymphs, they seldom exceeded 5 per cent. of the population. They were most numerous in grain with a moisture content of 16–16·3 per cent. (80 per cent. relative humidity). At a moisture content of 17·2 per cent. and particularly at 18·1–18·5 per cent. (relative humidities of 83–84 and 86–88 per cent., respectively), the grain became mouldy, and the mites died out. Complete mortality also took place in grain with a moisture content of only 12·1–12·2 per cent. (corresponding to about 48–49 per cent. relative humidity).

RAUCOURT (M.). **Découverte récente d'un nouvel insecticide l'hexachlorocyclohexane.**—*La Nature* no. 3093 pp. 235–236, 1 ref. Paris, 1945.

The author describes the physical and chemical properties of benzene hexachloride (hexachlorcyclohexane) [*cf. R.A.E.*, A **33** 256], the insecticidal properties of which were first observed in France in 1941, when samples of a mixture of the four known isomers, prepared by a new commercial method, were found to be very toxic to clothes moths. It is not toxic to man and has caused no injury to plants, while it appears to act as a stomach poison, a contact poison and a fumigant against insects [*cf.* **33** 257].

Tests carried out in 1942–45 confirmed its superiority to naphthalene and paradichlorbenzene against clothes moths and showed that its vapour kills house-flies [*Musca domestica*, L.]. It gave practically complete control of *Leptinotarsa decemlineata*, Say, on potato when applied in 2·5–3 per cent. dusts at the rate of 18–27 lb. per acre or in sprays of 0·3–0·5 lb. per 100 gals., and of flea-beetles on cultivated plants, particularly *Aphthona euphorbiae*, Schr. (*virescens*, Foudr.), on flax, in 5 per cent. dusts. A single application of a spray of 1·2 lb. per 100 gals. gave good results against species of *Hoplocampa* and *Rhynchites* on fruit trees and reduced infestation by *Anthonomus pomorum*, L., on apple from 80 to 10 per cent. The same spray is effective against several species of Aphids and has much more residual effect against them than the standard nicotine sprays. The sulphide and thiocyanate derivatives of benzene

hexachloride have been prepared and appear to be at least equal to it in insecticidal properties, the sulphides being particularly effective against *L. decemlineata*.

SMITH (C. M.) & GOODHUE (L. D.). **Increase in Concentration of Insecticide in Freon-12 accompanying Transfer or Discharge of an Aerosol-producing Solution.**—*Industr. Engng Chem.* Anal. Edn. **16** no. 6 pp. 355–357, 3 figs., 3 refs. Easton, Pa., 1944.

One of the problems in the production of insecticidal aerosols is the concentrating effect that occurs in the transfer or discharge of solutions in liquefied gases because of the evaporation of solvent from the solution remaining in the container as liquid is withdrawn from it [*cf. R.A.E.*, A **33** 99]. The authors provide a mathematical treatment for calculating this effect at any given fixed temperature, and describe experiments by which the validity of the method is confirmed for solutions in dichlordifluoromethane.

BARTHEL (W. F.). **An Extractor for Use with reduced Pressure.**—*Industr. Engng Chem.* Anal. Edn. **17** no. 1 pp. 53–54, 1 fig., 6 refs. Easton, Pa., 1945.

In the course of work on the preparation of purified pyrethrin concentrates [*cf. R.A.E.*, A **33** 189], it was desirable to know whether any of the newer commercial solvents could be used for the extraction of pyrethrum flowers. As the structure of the pyrethrins is altered and their toxicity to insects greatly reduced when they are heated at temperatures above 100°C. for any length of time and many of these newer solvents have too high a boiling point to be distilled on a steam bath at atmospheric pressure, the extractor described in this paper was designed to permit their use at reduced pressures. It has been used at reduced pressures with many solvents that boil at temperatures between 90 and 125°C. (760 mm.) ; it may also be used satisfactorily under atmospheric conditions when desirable.

HERIOT (A. D.). **Comparison of the Injury to Apple caused by Scales and Aphids (Homoptera : Aphididae & Coccidae).**—*Proc. ent. Soc. B.C.* **41** pp. 13–15, 4 refs. Vernon, B.C., 1944.

It is generally assumed that the injury caused to trees by both Aphids and scale insects is due to the withdrawal of sap during feeding, but the scale insects are much the more injurious though they increase less rapidly. Thus *Lepidosaphes ulmi*, L., has only one generation a year and attacks only woody growth, but frequently causes the death of twigs and branches of apple in neglected orchards in British Columbia, whereas *Aphis pomi*, Deg., produces nine or more parthenogenetic generations and attacks both leaves and stems, but causes relatively insignificant injury. Even *Quadraspidiotus* (*Aspidiotus*) *perniciosus*, Comst., which has three or four generations a year and is the most prolific Coccid attacking apple, but reproduces sexually, has a much lower reproductive potential than the Aphid, though it sometimes builds up larger populations than the latter, owing to its being less affected by natural enemies and adverse climatic conditions.

The author suggests that the discoloration round the feeding punctures of both Coccids is due to mechanical injury caused by the insertion of the stylets into the plant tissues and not to the injection of a toxic substance, and that this injury is of greater importance than the withdrawal of sap. The stylets of both Aphids and Coccids are renewed at each ecdysis [*R.A.E.*, A **23** 122], but those of the Aphids are withdrawn from the plant tissues and shed with the skin, whereas those of the immobile Coccids remain embedded in the plant.

The examination of cross-sections of bark infested by Coccids shows that the stylets pass through the cells and that the tips frequently extend into the xylem. As the Coccids moult three times during development, an infested twig must contain at least three sets of stylets for each visible adult, but where young Coccids settle beneath the parent, the congestion of abandoned stylets is much greater than could be estimated from the number of scales present at a given time. This disposal of stylets in the tissues results in mechanical injury all the year round, unlike the withdrawal of sap or the injection of a toxic substance, which occurs only during the life-time of the insect, and it is believed to be responsible for the severity of injury due to Coccid infestations.

GLENDENNING (R.). **The Parsnip Webworm** (*Depressaria heracleana*) **and its Control in British Columbia (Lepidoptera : Oecophoridae).**—*Proc. ent. Soc. B.C.* **41** pp. 26–28, 1 ref. Vernon, B.C., 1944.

Depressaria heracleana, L., all stages of which are briefly described, became of importance as a pest of parsnips grown for seed in the lower Fraser Valley in 1940, when the cultivation of this crop was increased. Infestation has averaged about 30 per cent. of the crop, and as many as 80 per cent. of the seed umbels have been infested in parts of fields near to good hibernation sites ; nearly all the seed in infested umbels is destroyed. The overwintered adults appear in May and the females oviposit in the umbels among the developing flowers and seeds until late June and early July. They may travel considerable distances, since new crops several miles from previous infestation generally become infested during June. The larvae web together the small umbels and feed on the flowers, bracts and young seed heads for about three weeks, and then enter the main stem, generally near the axils of the lowest two leaf stalks, and pupate in chambers hollowed out in the pith. Several larvae may pupate in the same chamber. The adults emerge during July and early August and immediately seek hibernation quarters in sheds, wood-piles and other shelter, where they overwinter in narrow crevices. Many were found in August between the folds of empty paper cement bags in an open shed, and others in piles of closely-packed stakes and fence palings. *Heracleum lanatum*, a weed chiefly confined to acid bogs, was the only other food-plant observed ; where it was at all abundant it always supported large populations and therefore constitutes an important source of infestation, to which is attributed the almost certain infestation of new plantings.

Natural control was not of great importance. Mortality among adults kept under cage conditions in a natural environment throughout the winter was 40 per cent., and a few Dipterous and Hymenopterous parasites, none of which was numerous, were noted in the field. In 1941, bats were observed feeding on the adults, and later no hibernating moths could be found in sheds nearby, though they were plentiful in such sites at a place four miles distant where bats were not seen. The hairy woodpecker, *Dryobates villosus*, has been recorded feeding on the larvae and pupae in the stems.

The risk of heavy infestation can be reduced by cutting back all plants of *H. lanatum* growing within a mile or two of the seed-crop before they flower, clearing sheds in which moths have hibernated in appreciable numbers and spraying them with diesel or stove oil, and restacking piles of wood in cold, wet weather. Seed from which plants for a new seed-crop are to be grown should not be sown within 100 yards of the seed crop as the larvae occasionally enter the crown of seedling parsnips to pupate and so render them liable to subsequent rotting. Arsenical sprays and dusts do not give satisfactory control of the larvae in their webs, and dusts containing derris, pyrethrum extract or nicotine were ineffective in tests in 1941 and 1942. A proprietary dust containing barium fluosilicate gave good results in 1942, however, and on the

basis of further tests in 1943, a mixture of cryolite and talc (1 : 3) is recommended. Almost complete mortality of the larvae in the webs was given by two applications of this dust, the first being made when there were 5–6 webs on each plant and the larvae were almost half-grown, and the second ten days later. The dust was applied by means of rotary hand equipment, and 50–100 lb. is needed to treat an acre. The treatment is economically practicable. The mode of action of the dust is not known, as it does not appear to be necessary for it to touch the larvae at the time of application, though they may later come into contact with it on or in their webs. Death may occur within four hours, though 24–48 hours are generally necessary for 99 per cent. mortality.

DOWNES (W.). **Recent experimental Work on the Control of the Apple Sawfly, *Hoplocampa testudinea* (Hymenoptera : Tenthredinidae).**—*Proc. ent. Soc. B.C.* **41** pp. 29–30, 2 refs. Vernon, B.C., 1944.

In view of promising results in 1941 [*R.A.E.*, A **31** 211], further tests with sprays containing summer oil and nicotine sulphate for the control of *Hoplocampa testudinea*, Klug, on apple in British Columbia were carried out in 1942 and 1943. The sprays were applied immediately after petal-fall and the results estimated by the percentages of injured fruits (infested or scarred) a month later, when the larvae were leaving the applies. The oils used had viscosities of 45–62 Saybolt and unsulphonatable residues of 77–90 per cent., and the emulsifier was powdered skim milk. Lead arsenate (4½ lb. per 100 gals.) was added to all sprays to control Lepidopterous larvae [*cf. loc. cit.*]. The concentrations of oil and nicotine sulphate per 100 gals. were 1·21 gals. and 1·25 pints in 1942 and 1·5 gals. and 1·5 pints in 1943. The average percentages of apples injured by the larvae on sprayed and unsprayed trees were 5·06 and 47·5 in 1942 and 0·61 and 49·69 in 1943. The spray should be applied within a week of petal-fall and high pressure is not necessary ; the nozzle should be held close to the calyx and care taken that none is missed.

In 1943, a spray containing quassia extract and soap prepared as recommended in Germany [**25** 465] proved almost as effective as the oil and nicotine sulphate, but it is more difficult to prepare and twice as costly.

VENABLES (E. P.). **The European Red Mite in the Okanagan Valley of British Columbia (Acarina).**—*Proc. ent. Soc. B.C.* **41** pp. 33–35, 3 refs. Vernon, B.C., 1944.

The author discusses the influence of local conditions in determining the economic importance of *Paratetranychus pilosus*, C. & F., and the possible effect of control measures on the development of infestations in the irrigated apple orchards of the Okanagan Valley. This mite causes defoliation in non-irrigated orchards in the United States and eastern Canada, and may also affect the size and colour of fruit and the production of fruit buds, but defoliation is rare in the irrigated Okanagan orchards, though leaves that have turned yellow as a result of mite injury may fall after the application of summer oil. Heavy infestation of the leaves would have to occur early in these orchards to have much effect on the development of the fruit buds, which is generally well advanced by late June or early July, while the colour and size of the fruit would be affected by later infestations ; irrigation during the critical periods would tend to reduce these injuries.

In certain orchards in which early sprays are applied each season against *P. pilosus*, winter eggs are again sufficiently numerous to necessitate similar treatment the following year, whereas in neighbouring unsprayed orchards of the same variety, populations remain low. Observations over many years have shown that most winter eggs are destroyed by suitable dormant sprays, but that infestation frequently develops later in the season. Summer sprays, applied early, control the mites for a short period, but the foliage remains

green and provides an adequate food supply for the survivors, from which populations capable of depositing normal numbers of winter eggs are built up. Sprays applied at midsummer appear to give excellent control, but the seasonal decline has then started, and the mites have often also disappeared from unsprayed trees. The scarcity of food that results from depletion of the leaves by infestation is regarded as an important natural check. It operates on unsprayed trees, on which the injury begins early and becomes increasingly severe ; as a result the mite populations decline progressively and winter eggs may be deposited early. These may be infertile [*cf. R.A.E.*, A **22** 657] and are in any case exposed to predators for a longer period than those deposited on trees protected by early sprays. It is pointed out that the presence of large numbers of winter eggs is not always followed by heavy mite infestations, and that attack may be serious on trees with relatively few winter eggs.

GAINES (J. C.). **Insecticide Tests for Bollworm Control.**—*J. econ. Ent.* **37** no. 6 pp. 723–727, 1 fig., 6 refs. Menasha, Wis., 1944.

The results are given of two experiments on the control of *Heliothis armigera*, Hb., on cotton, carried out in Texas in 1942. In the first, a commercial calcium arsenate (42 and 2·7 per cent. total and water-soluble arsenic pentoxide) was compared with calcium arsenate containing only 15·5 and 0·2 per cent. total and water-soluble arsenic pentoxide, lead arsenate (31·9 and 0·3 per cent. total and water-soluble arsenic pentoxide), copper hydroarsenate (16·8 per cent. total arsenic pentoxide or 41·3 per cent. copper arsenate) and basic copper arsenate (36·6 per cent. total arsenic pentoxide or 90·1 per cent. copper arsenate) ; the last material was mixed with equal quantities of pyrophyllite (Pyrax) to improve its dusting qualities. Seven effective applications were made at approximately five-day intervals from 30th June to 4th August, and all materials were applied at the rate of 7·5–9·5 lb. per acre per application except the mixture, which was applied at 17 lb. per acre. The average percentages of forms injured by the bollworm, percentages of squares punctured by *Anthonomus grandis*, Boh., and numbers of rapid plant bugs [*Adelphocoris rapidus*, Say] per 100 squares during the dusting period, the numbers of Aphids [*Aphis gossypii*, Glov.] per square inch of leaf area after six applications, and the yields in lb. seed cotton per acre were, respectively 3·6, 6·2, 4·4, 6·2 and 1,357 for basic copper arsenate, 6·4, 5·9, 5·0, 11·52 and 1,158 for commercial calcium arsenate, 5·3, 7·6, 4·0, 7·9 and 1,266 for lead arsenate, 11·0, 7·1, 3·4, 7·9 and 1,103 for copper hydroarsenate, 8·6, 7·2, 5·8, 4·1 and 1,024 for calcium arsenate containing a low proportion of arsenic, and 13·8, 13·6, 6·4, 2·09 and 835 for no treatment. Analyses of the significances of the differences show that, as regards control of *Heliothis*, basic copper arsenate was better than lead or commercial calcium arsenate, these were better than the other two dusts, and the latter were better than no treatment. The difference in yield required for significance was 118. The higher yield on plots dusted with copper hydroarsenate than on those dusted with calcium arsenate with a low arsenic content, although weevil infestation was about the same and bollworm injury and Aphid infestation were higher, indicates that the copper in the insecticide acted in some way to stimulate fruit production.

In the second experiment, the corresponding figures for *Heliothis*, *Anthonomus*, *Adelphocoris*, Aphids and yield were 6·0, 1·6, 1·4, 9·3 and 1,030 for the dust containing basic copper arsenate, 8·8, 2·8, 1·6, 9·24 and 940 for lead arsenate, 8·2, 2·5, 2·4, 5·13 and 961 for a dust of cryolite and sulphur (73·4 per cent. sodium fluoaluminate), 10·8, 2·8, 1·2, 12·5 and 830 for a commercial calcium arsenate (42·4 and 3·2 per cent. total and water-soluble arsenic pentoxide), 12·3, 2·6, 0·8, 22·71 and 656 for a special calcium arsenate of small particle size containing 43·1 and 19·2 per cent. total and water-soluble arsenic pentoxide, and 23·6, 5·2, 3·2, 6·65 and 362 for no treatment. The materials

were applied eight times at approximately five-day intervals from 19th July to 20th August at the rate of 6·8–9·8 lb. per acre per application, except the dust containing basic copper arsenate, which was applied at 17·5 lb. per acre. Rain washed off one application and reduced the value of two others. The Aphid counts were made after seven applications, and all plots were dusted with 3 per cent. nicotine for Aphid control on 20th August. All treatments gave significant control of *Heliothis*, basic copper arsenate, lead arsenate and cryolite being approximately equal and the first significantly better than the calcium arsenates. The difference required for significance in yields was 366. Basic copper arsenate and lead arsenate appeared to be more effective than the other materials in showery weather.

The gains in yields resulting from the use of various dusts in experiments during the last seven years are shown in a table ; some of the gains were partly due to control of *Anthonomus*, but *Heliothis* was the major pest in most of the experiments. In all tests calcium arsenate was effective against the latter, but less so than some of the other insecticides. Cryolite was effective against it, but resulted in reduced yields when *Anthonomus* was present in injurious numbers. Lead arsenate was more effective than cryolite against the weevil and than calcium arsenate against the bollworm. The highest gains in yield resulted from basic copper arsenate when only the bollworm was injurious, and from alternate applications of calcium arsenate and lead arsenate against both bollworm and weevil.

GAINES (J. C.). **Control of the Cotton Aphid with different Forms of Rotenone and Nicotine.**—*J. econ. Ent.* **37** no. 6 pp. 728–729, 1 graph, 1 ref. Menasha, Wis., 1944.

Although serious infestation of cotton by *Aphis gossypii*, Glov., as a result of applications of calcium arsenate for the control of other insects is less common in Texas than in the south-eastern section of the cotton belt, it has developed in certain years. In a number of cases it occurred late in the season and caused only slight loss in yield, although it reduced the quality of the cotton. Plots treated with a mixture of calcium arsenate and rotenone in 1941 gave higher yields than those treated with calcium arsenate alone [*cf. R.A.E.*, A **31** 399], and tests were carried out in 1942 to compare the effect on Aphid infestation of commercial calcium arsenate, mixtures of commercial calcium arsenate with 20 per cent. sulphur and 0·5 per cent. rotenone, which was used in three forms (extractive, " activated " extractive and ground root), alternate applications of commercial calcium arsenate alone and containing 2 per cent. nicotine (nicotine sulphate), and a " neutral " calcium arsenate (pH 9·8). The dusts were applied nine times at five-day intervals during July and August. The calcium arsenates used alone increased infestation, the mixtures with rotenone kept it at about the same level as on untreated plants, and the nicotine reduced it a little. Activated rotenone was apparently no more effective than the usual forms. All treatments increased the yield and reduced infestation by the boll-weevil [*Anthonomus grandis*, Boh.] and injury by the bollworm [*Heliothis armigera*, Hb.], with little difference between them ; apparently the addition of sulphur and rotenone or nicotine did not affect the toxicity of calcium arsenate to these insects. The neutral calcium arsenate gave better bollworm control and a little higher yield than the standard form.

In another test in which dusts containing 0·5 per cent. rotenone (activated extractive or ground root), 0·5 per cent. nicotine, 0·25 per cent. each of rotenone and nicotine, or 3 per cent. nicotine as nicotine sulphate or free nicotine were used to control a heavy infestation of Aphids that developed after applications of calcium arsenate, the 3 per cent. nicotine dusts were more effective than any others.

It is concluded that on most fertile soils, where several applications of calcium arsenate are nearly always needed for insect control, alternate applications with calcium arsenate containing 2 per cent. nicotine for the control of the Aphid should be profitable, but that on the upland soils where fewer applications are needed, a single final application may be relied on to control the Aphid in those years in which it becomes injurious.

BARBER (G. W.). **Effect of Mineral Oil containing an Insecticide on the Tips of Sweet Corn Ears.**—*J. econ. Ent.* **37** no. 6 pp. 730–733. Menasha, Wis., 1944.

The following is substantially the author's summary of this account of investigations carried out in California and Idaho in 1942. In commercial and experimental use of the mineral-oil treatment for the control of *Heliothis armigera*, Hb., in sweet maize [*cf. R.A.E.*, A **31** 274, etc.], it was found that an increase in the length of undeveloped tips of treated ears might result either from inhibition of the development of immature kernels if the oil reached them, or from interference with pollination if a secondary growth of the cob occurred, as evidenced by the late appearance of a tuft of fresh silk from the tip kernels. Whether oil did or did not reach the kernels was determined by the length of the husk extension and the dosage of oil. No significant difference was found between the increase in length of undeveloped tips caused by oil alone and by oil containing pyrethrins, dichlorethyl ether or ethylene dichloride. Oil applied at a dosage of 0·5 cc. to ears having a husk extension of at least two inches caused negligible increases in the length of the undeveloped tips, but the length of the undeveloped tip was increased when the husk extension was less or the dosage was greater. The evidence showed that it was safer to begin the treatment on the seventh day rather than the sixth day after silk exposure. The average increase in the length of undeveloped tips caused by commercial or experimental oiling of Golden Cross Bantam sweet maize was not more than 0·4 inch per ear. In a seven-inch ear this represents a loss of only about 5 per cent. of the kernels, which is thought to be of very minor importance as compared with the great improvement in quality, quantity and value of the crop resulting from the proper application of the treatment.

LANGE jr. (W. H.). **The Effect of the War on Truck Crop Insect Control in California.**—*J. econ. Ent.* **37** no. 6 pp. 734–737, 7 refs. Menasha, Wis., 1944.

Since 1942, research work of an immediate nature has been carried out in the Salinas Valley of California and its neighbourhood on the larger areas of commercial vegetable crops and certain field crops, and some of the more important insects with recent developments in their control are discussed in this paper.

Limonius californicus, Mannh., *L. canus*, Lec., and *L. infuscatus*, Motsch., continue to be very injurious on irrigated lands. Granulated calcium cyanide drilled into the soil at the rate of 100 lb. per acre in trap crops of beans, or in certain instances among seedling plants, has given kills of 68–85 per cent. This method is of limited value, as often many wireworms are not attracted to the bait crop, so that several applications may be necessary. During 1943 and 1944, dichlorethyl ether was applied directly to small seedling lettuces at the rate of 600 U.S. gals. of 0·5 per cent. emulsion per acre, chiefly as a repellent; this treatment is effective only if applied before thinning and before severe damage has occurred.

During 1943, dusts of free nicotine and cryolite or calcium arsenate usually gave good control of Aphids and caterpillars on cabbage; the dusts contained 2·5–3 per cent. nicotine and usually neutral carriers. It was found that 30 per cent. cryolite was not very effective against larger larvae of the imported

cabbage worm [*Pieris rapae*, L.], but a dust containing 0·5 per cent. rotenone and 3 per cent. nicotine was used on older cabbage at 40–50 lb. per acre with excellent results, giving approximately 85 per cent. kill of *P. rapae* in 7–10 days. The addition of dichlorethyl ether did not materially improve the effectiveness of free nicotine against caterpillars, but increased the kill of cabbage Aphids [*Brevicoryne brassicae*, L.] by approximately 10 per cent. when added to 2 per cent. nicotine. A dust containing 3 per cent. nicotine was found to be necessary for adequate control of *B. brassicae* by ground machines, and a 4 per cent. dust was more effective for application by aeroplane ; the best results with free nicotine dusts were obtained when the plants were moist and when the dusts remained in the rows long enough to penetrate the heads adequately.

Pemphigus (*Prociphilus*) *betae*, Doane, continued to be injurious to lettuce, to which it migrated from sugar-beet, docks and other weeds, especially during August and September, apparently having no sexual cycle in California. It attacks the roots, and chemical treatments have not been effective, but adequate irrigation, fertilisation and cultivation often help to prevent serious injury. *Frankliniella helianthi*, Moult., has caused severe damage to bush types of bean during July and also occurred on peas. A dust of free nicotine and cryolite, of the same type as that used on cabbage, caused a satisfactory reduction of population when applied at 35–40 lb. per acre. *Autographa egena*, Gn., seriously injured pole beans during October 1943, and the bean root aphid, *Trifidaphis radicicola*, Essig, was found infesting field-planted small white beans during the same autumn. Damage to lettuce, beans, sugar-beets and cauliflower seedlings by the garden centipede [*Scutigerella immaculata*, Newp.] increased during 1943–44. An emulsion of dichlorethyl ether had a repellent effect when used on small lettuce seedlings before thinning in the same way as against wireworms, but is a temporary treatment suitable only for high-priced land.

Various sprays were tested against the onion thrips [*Thrips tabaci*, Lind.] when it was present in considerable numbers on onion in 1942, but the best gave only 50 per cent. control ; it is stated in a foot-note that a spray containing 0·13 per cent. DDT [2, 2-bis (parachlorphenyl)-1, 1, 1-trichlorethane] applied twice at 190 U.S. gals. per acre has recently proved more effective than any of them. The seed-corn maggot, *Hylemyia cilicrura*, Rond., is becoming a serious pest of seedling onions, but a solution of 0·25 per cent. dichlorethyl ether applied at the rate of 900 U.S. gals. per acre adequately checked the damage without affecting the seedlings. This Anthomyiid also causes severe damage to spinach, lucerne and bean seedlings and can bore inside the larger spinach stems and in the hearts of celery. The onion maggot, *H. antiqua*, Mg., was injurious only in small areas ; dichlorethyl ether at 0·5 per cent. was effective against it, but should not be applied to small seedlings at this strength as some injury may occur. *Idiopterus* (*Micromyzus*) *formosanus*, Takah., was found on stored Australian brown onions, and on field-planted garlic during May 1944.

Aphis ferruginea-striata, Essig, has caused serious damage to carrots, occurring in large colonies about the crowns.

PLANK (H. K.). **Insecticidal Properties of Mamey and other Plants in Puerto Rico.**—*J. econ. Ent.* **37** no. 6 pp. 737–739, 8 refs. Menasha, Wis., 1944.

The results are given of preliminary tests for insecticidal properties of the aerial portions of plants other than *Derris* and *Lonchocarpus* that occur in Porto Rico. The materials were air-dried in the shade at room temperature, and ground and applied heavily to pieces of the leaves of food-plants of the insects to be tested. A number of plant parts, a list of which is given, showed a toxicity of 40 per cent. or less with much feeding when tested against 3–6 species of insects, but parts of some of the others showed up to 95·9 per cent. toxicity, mostly with little or no feeding. The most outstanding were the mature seeds of mamey (*Mammea americana*) and of some introductions of the yam

bean, *Pachyrhizus erosus* var. A. The toxicity of the bark, leaves, mature seeds, hulls and a mixture of mature seeds and hulls (67 : 33) of mamey and of the pods and mixtures of seeds and pods (50 : 50) of three races of the yam bean to adults of *Cerotoma ruficornis*, Ol., and larvae of *Diaphania hyalinata*, L., *Laphygma frugiperda*, S. & A., and *Plutella maculipennis*, Curt., are given in a table, which shows that the mamey seed hulls and yam-bean pods were practically inert, but that mamey bark and yam beans mixed with pods were the only other materials that permitted any feeding, and that only by *C. ruficornis* and *L. frugiperda*.

The ground seeds of *M. americana* appeared to act as a contact insecticide. A spray of 8 lb. per 100 U.S. gals. water, without a spreading agent, killed 44·1 per cent. of *Myzus persicae*, Sulz., on *Brassica perveridis* and 43·4 per cent. of *Macrosiphum sonchi*, L., on *Senecio confusus* in two days without injuring the plants. Under field conditions, a spray of 8 lb. per 100 U.S. gals. water with 6 oz. Grasselli Spreader-sticker applied to infested cauliflowers gave 67·9 per cent. control of *P. maculipennis* and 73·6 per cent. control of a few larvae of *Ascia monuste*, L., in four days, as compared with 73·5 and 87·5 per cent. control, respectively, with nicotine sulphate (1 : 800) with the same amount of adhesive. The mixed dust of seeds and hulls gave 80 per cent. kill of larvae of *P. maculipennis* on cabbage in four days, and the deposit was still toxic after exposure to sun, wind and dew for four days. An extract prepared by soaking 8 oz. mamey-seed powder in 1 U.S. quart kerosene for 24 hours at room temperature, with intermittent agitation, and filtering, was toxic to household insects including flies, cockroaches and ants, principally *Paratrechina* (*Prenolepis*) *longicornis*, Latr. It appeared to act slowly when applied with a small hand sprayer in the open, but permitted little recovery.

No insects of importance attack *Mammea americana* in Porto Rico ; larvae of *Myelois notabilis*, Wlk., were found just inside the hulls of about 1 per cent. of the seeds that had weathered, but this attack was believed to be secondary. No insect infestation was found in seeds gathered and separated from the pulp soon after the fruit had fallen.

Hovanitz (W.). **Physiological Behaviour and Geography in Control of the Alfalfa Butterfly.**—*J. econ. Ent.* **37** no. 6 pp. 740–745, 1 fig., 9 refs. Menasha, Wis., 1944.

The author considers that *Colias chrysotheme*, Esp., is represented in North America by an orange race (alfalfa butterfly), for which he uses the name *C. eurytheme*, Boisd. [*cf. R.A.E.*, A **33** 81], and a yellow race (clover butterfly) divisible into several forms. Ovipositing females of *C. eurytheme* are very strongly attracted by lucerne and those of the yellow race by red clover [*Trifolium pratense*]. *C. eurytheme* occurs in southern Canada, the United States and the Uplands of Mexico, but is common enough to be a pest of lucerne only in the interior valleys of California and Arizona, and the bearing on this of recent studies by the author on the genetics and physiology of the *chrysotheme* complex is discussed.

Three factors affect the relations of *C. eurytheme* to its environment : its wild food-plants are small, so that one can support only a few larvae, and are usually scattered, with the result that the larvae are widely separated ; the female lays only one egg at a time, always taking flight before laying another, so that the eggs are scattered over large areas ; and the females take very long flights and tend to congregate in large numbers where there is a good crop of lucerne. Owing to these factors, serious economic injury is caused only in regions where there are many lucerne fields close together. It was found that the adults present in recently cut fields were nearly all females, whereas in those with lucerne half to full grown they were nearly all males. In the valleys of California and Arizona in which *C. eurytheme* is injurious, fields several

hundred feet wide and half a mile or more long are cut transversely in sections starting from one end; the eggs are deposited in the newly cut sections and give rise to adults in 3–4 weeks in summer, before the lucerne on which they develop is ready for cutting. These oviposit in the sections that have just been cut so that very large populations develop. In such areas cooperation in the arrangement of cutting dates will afford control. The importance of *C. eurytheme* is also closely correlated with climatic conditions, and use might be made of the physiological limits of the species to control it. Thus, in the arid regions of California and Arizona, weeds, especially sunflowers, that protect the adults from the midday sun, can be destroyed, and the elimination of flowering lucerne and weeds, from which the females obtain nectar, will reduce their egg-laying capacity by 95 per cent. or more.

The two races of *C. chrysotheme* interbreed and produce fertile hybrids, particularly where lucerne and clover occur in the same fields. There is a high degree of mortality among the hybrid individuals, but hybridisation apparently does not produce sterility directly. There is also a high frequency of sterility in orange individuals that have developed on clover and yellow ones that have done so on lucerne. At present, members of this complex are not agricultural pests in any area where interbreeding occurs, and it is possible that biological control might be effected by growing mixed fields of red clover and lucerne. The author also discusses other genetic and physiological variations and fluctuations, for which no practical use is yet apparent.

Sweetman (H. L.) & Gyrisko (G. G.). **Latent Injury from Pyrethrum and Rotenone Dusts.**—*J. econ. Ent.* **37** no. 6 pp. 746–749, 1 fig., 3 refs. Menasha, Wis., 1944.

The following is substantially the authors' summary. It was observed in a series of tests that pyrethrum and rotenone dusts produced a latent injury among firebrats (*Thermobia domestica*, Pack.) that survived the acute toxic effects of the poisons. The symptoms consisted of discoloration and sloughing off of various appendages, and when discoloration occurred the injury was progressive, and death followed, sometimes after a few days and sometimes after several weeks. Some samples of pyrethrum did not produce the typical latent symptoms.

Starr (D. F.) & Shaw (J. G.). **Pyridine as an Attractant for the Mexican Fruitfly.**—*J. econ. Ent.* **37** no. 6 pp. 760–763, 4 refs. Menasha, Wis., 1944.

The following is based on the authors' summary. Studies made in Mexico in two localities of different altitude and climate showed that a solution of pyridine in alcohol increased the attractiveness of a yeast-fermented sugar bait for *Anastrepha ludens*, Lw., whether added directly to the sugar solution or used in auxiliary vials. Solutions of 12–25 per cent. pyridine by volume were used in the vials, and the amounts of pyridine and alcohol added directly were usually 0·1 or 0·2 per cent. and about 1 per cent. of the bait, respectively, though as much as 1 per cent. pyridine was effective.

The attractiveness of the bait showed a distinct seasonal effect. The increase due to pyridine was 98–143 per cent. in April and May, but only 10–58 per cent. in other seasons. During the winter months, the best combination tested was 0·1 per cent. pyridine and 1 per cent. alcohol, but during warm weather the addition of alcohol made little difference. There was little difference in the efficiency of pyridine in *Citrus* and mango trees. In black sapote trees (*Diospyros ebenaster*), where the average fruit-fly catch was greatest, there was least increase due to pyridine.

DOHANIAN (S. M.). **Control of the Filbert Worm and Filbert Weevil by Orchard Sanitation.**—*J. econ. Ent.* **37** no. 6 pp. 764–766, 2 refs. Menasha, Wis., 1944.

An account is given of investigations on the control of *Cydia* (*Melissopus*) *latiferreana*, Wlsm., and certain weevils, chiefly *Curculio uniformis*, Lec., attacking filberts [*Corylus avellana*] in the Pacific Northwest by picking up the nuts that drop prematurely before the larvae in them can complete their development [*cf. R.A.E.*, A **29** 405]. Larvae in the mature crop are destroyed at the processing plant. During the preharvest season, larvae of *Cydia* feed for about 20 days and then bore out of the nuts and hibernate in tough cocoons within the first 2–3 inches of soil or occasionally in rolled leaves or débris on the ground. Those of *Curculio* require a few more days to mature, but some of them complete their development before harvest, leave the nuts, form cells in the soil at a depth of ten inches or more and remain in them for 2–3 years. Counts made in 1938–43 showed that though only 15·3 per cent. of the nuts produced dropped prematurely these included rather more nuts infested by *Cydia* than those gathered at harvest; the position with regard to *Curculio* was found to be similar. In experiments in which dropped nuts were gathered every ten days in 1942 and every seven days in 1943, only 5–7 per cent. of the larvae were able to escape; shortening the interval between successive collections improved the control of *Cydia*, but not of *Curculio*. The cost compared very favourably with that of spraying.

The larvae of the various insects found infesting the nuts showed decided preferences for certain varieties; *Cydia* and *Curculio* preferred some of the pollinisers, and the custom of allowing the nuts under the pollinising varieties to remain unpicked until sufficient have accumulated to make it profitable for the pickers to work has been one of the chief reasons for the gradual increase in infestation once the insects have become established in an orchard. Although gathering and burning dropped nuts once a week seems adequate to keep the infestation low in normal seasons, more frequent picking of those under the pollinisers is recommended. It is possible to use pigs for removing the premature drops.

The author points out that the effects of these measures will not be fully evident until the third or fourth year after they are started and that the absence of an effective insecticidal treatment against *Curculio uniformis* is an additional reason for employing cultural measures of control.

OSBURN (M. R.) & MATHIS (W.). **Effect of cultural Practices on the *Citrus* Rust Mite.**—*J. econ. Ent.* **37** no. 6 pp. 767–770, 1 fig. Menasha, Wis., 1944.

The following is based on the authors' summary of this account of investigations carried out in Florida in 1940–43. A comparison of the numbers of *Phyllocoptruta* (*Phyllocoptes*) *oleivorus*, Ashm., found on orange trees showed no difference in infestation between trees growing in clean-cultivated plots and in plots having a cover crop, though there were very small differences between the temperatures and humidities recorded. The cultivation employed to obtain clean plots stimulated the trees subjected to this treatment each season so that they were more vigorous and in better physical condition than were those in the cover-crop areas. There was some evidence that trees in cultivated areas were more heavily infested with *Chrysomphalus ficus*, Ashm. (*aonidum*, auct.) than were those in the cover-crop areas.

BARNES (O. L.). **Time Schedules for Grasshopper Surveys in Arizona.**—*J. econ. Ent.* **37** no. 6 pp. 789–795. Menasha, Wis., 1944.

In Arizona, accurate grasshopper surveys are practically impossible without the use of time schedules based on the seasonal histories of important species

in different agricultural areas of the State, in which the climate varies widely, owing largely to great differences in elevation. The author therefore gives information regarding the average dates of major events in the seasonal histories of species in different areas, based on observations made in 1936–43 in representative habitats and areas in Yuma, Maricopa, Yavapai and Coconino Counties. He suggests the most probable dates for the making of efficient surveys, which involves combining those of different species and confining annual surveys to favourable habitats, inspection of which would show whether populations were high enough to warrant a more thorough and detailed survey; he also shows the value of reviewing the survey reports of preceding years in planning new surveys; and discusses the effect of rainfall and irrigation practices in causing variations in the seasonal histories.

Cressman (A. W.) & Broadbent (B. M.). **Changes in California Red Scale Populations following Sprays of Oils with and without Derris Resins.**—*J. econ. Ent.* **37** no. 6 pp. 809–813, 1 fig., 8 refs. Menasha, Wis., 1944.

The following is based on the authors' summary of this account of investigations carried out in California in 1940–43. Populations of the California red scale [*Aonidiella aurantii*, Mask.] on lemon trees were measured on the wood, with a few counts on fruit, just before they were sprayed with emulsions of various oils, alone and with added derris resins, and again about 6–12 months afterwards. In five groves treated with light medium and heavy medium oil, final infestation on the wood was about 2·3 times as heavy in the plots treated with oil alone as in those where derris resins were added. Infestation on the fruit was also heavier when no derris was used. There was no difference in either the immediate or the residual effectiveness of the light medium and heavy medium oils whether or not derris resins were added, but a light medium oil showed more residual action than an extra light oil.

In general, the relative rate of population increase was greater the smaller the number of insects surviving the sprays, and differences in the final populations were less than the differences in survival.

Rosenstiel (R. G.), Ferguson (G. R.) & Mote (D. C.). **Some ecological Relationships of** *Cnephasia longana*.—*J. econ. Ent.* **37** no. 6 pp. 814–817, 2 figs., 1 ref. Menasha, Wis., 1944.

Observations in Oregon showed that the adults of *Cnephasia longana*, Haw., oviposit during the summer, from half an hour after sunset until midnight and lay their eggs on surfaces such as the rough bark of trees, usually at a height of 2–20 ft. [*cf. R.A.E.*, A **30** 126]. The larvae hibernate in bark crevices or other shelter in the first instar. When they emerge in spring, they spin strands of silk and are blown away by the wind. By plotting the injury they caused in fields of flax or vetch near hibernating quarters it was found that there is a drift of first-instar larvae during early spring from the south-west, west or north-west, the drift distance varying with the height at which the larvae leave their support and with the wind velocity, though barriers such as buildings or brush hedges deflect wind currents upward so that the larvae are carried further than they would otherwise be. Douglas fir [*Pseudotsuga taxifolia*] and oak are the most important sources of drifting larvae because of their height and their numerous bark crevices, which furnish a refuge for hibernation; rough or shingled unpainted buildings may be the source of a number of larvae where trees are scarce. If the overwintering population is concentrated, many larvae may drop to the ground within 5–10 yards of such low trees as filberts or small fruit trees; the only definite western drift observed was under such conditions. Drifting from fence posts and telephone poles is relatively unimportant.

It was found that first-instar larvae move downwards if they alight at any height above the ground and so do not injure tall plants such as fruit trees and cane fruits ; older larvae feed on tender growing plant tissue and may ascend or descend to find it. Graminaceous plants are attacked only by the older larvae that have fed in the earlier stages on another plant nearby. Larvae that fall on clean cultivated ground may travel a few inches in search of food but will soon starve, and late-planted crops such as maize or potatoes therefore escape injury if grown on such ground. Crops that germinate early in the spring, such as flax, will be injured to a degree depending on the concentration of the larval population and the length of time for which they are exposed to drifting larvae. An increase in *Cnephasia* populations is favoured by the growing of leguminous plants ; the average amount of injury caused to flax by the larvae during six years was four times as great when it was preceded by leguminous plants as when it was preceded by a grain crop.

WEBSTER (R. L.). **Insecticide Situation in the Pacific Northwest.**—*J. econ. Ent.* **37** no. 6 pp. 818–821, 2 refs. Menasha, Wis., 1944.

The author discusses the quantities of the principal insecticides used per year on fruit trees, vegetables and cranberries in the State of Washington, the problem of the accumulation of arsenic in the soils of sprayed orchards, and possible means of reducing the quantities of lead arsenate and some of the scarcer insecticides.

SEARLS (E. M.), FLETCHER (F. W.) & KENAGA (E. E.). **Methyl Bromide as a Fumigant for Dairy Factories.**—*J. econ. Ent.* **37** no. 6 pp. 822–829, 4 figs., 10 refs. Menasha, Wis., 1944.

An account is given of 15 tests carried out in representative commercial dairy plants and cold storage warehouses throughout the cheese-producing areas of Wisconsin in the summers of 1942 and 1943 to determine the efficiency of methyl bromide as a fumigant for controlling the pests sometimes associated with this industry. Practical methods of preparing buildings for fumigation and various ways of applying the gas, which were developed for treating these plants economically and with little interference to normal factory operations, are described ; recommendations for dosages, and suggestions with regard to circulation of the gas, ventilation of the buildings after fumigation and safety precautions are included.

Methyl bromide had no adverse effect on dairy products or factory equipment. The quantities per 1,000 cu. ft. recommended for use in cheese factories are $1\frac{1}{4}$ and $1\frac{1}{2}$ lb. against *Piophila casei*, L., at 80 and 70°F., respectively, 1, $1\frac{1}{4}$ and $1\frac{1}{2}$ lb. against *Blattella germanica*, L., at 80, 70 and 60°, and 1 lb. against *Tyrolichus casei*, Oudm. (*Tyroglyphus siro*, auct.) at 70°, the period of exposure being eight hours, the circulation period (during which fans are run in each room under fumigation) half an hour, and the ventilation period after fumigation before the buildings are entered two hours in each case. Cold storage warehouses, in which only *T. casei* is important, may be fumigated with $\frac{3}{4}$ lb. methyl bromide per 1,000 cu. ft. at a temperature of 50°F. for 24 hours, with circulation and ventilation periods of one and eight hours, respectively. Other insects and spiders were readily controlled by methyl bromide fumigation ; spiders and ants seemed to be the most resistant forms. Smaller dosages at lower temperatures are effective against rats and mice.

MALLIS (A.). **Concentrations of Sodium Fluoride-Flour Mixtures for Silverfish Control.**—*J. econ. Ent.* **37** no. 6 p. 842, 1 ref. Menasha, Wis., 1944.

The results are given of experiments in California to determine what concentrations of a mixture of wheat flour and sodium fluoride, which is often

used as a bait for the control of *Ctenolepisma urbana*, Slabaugh, were most effective. Mixtures containing from 1 to 90 per cent. sodium fluoride were tested. Jars bound with tape [*cf. R.A.E.*, A **30** 435] and containing a teaspoonful of flour, sodium fluoride or mixture were distributed in a badly infested building and removed every 24 hours, those containing silverfish being subsequently kept at room temperature during the observation period. Increasing the proportion of sodium fluoride to over 9 per cent. reduced the catch. The mean length of life after entering the trap fell from 27·4 days in flour to 3·9–6·7 in mixtures containing 3 per cent. sodium fluoride or more, a difference of 4·1 days being required for minimum significance. Life in the 5 per cent. mixture averaged 4·3 days, and it is therefore recommended that the baits should not contain more sodium fluoride than this. Experience has shown that for the best results, the dry bait should be thoroughly mixed and then distributed in pinches at intervals of 1–3 ft. behind mouldings, in cracks and crevices and in such places as the corners of bookcases; application of this mixture in several badly infested buildings apparently gradually reduced the silverfish population.

Swingle (M. C.) & Mayer (E. L.). **Further Tests of synthetic organic Compounds as Insecticides.**—*J. econ. Ent.* **37** no. 6 pp. 843–844, 3 refs. Menasha, Wis., 1944.

In tests of 45 commercial organic compounds, a list of which is given, against 5–7 species of leaf-feeding insect pests of vegetable crops, most of them Lepidopterous larvae in the fourth instar, 37 showed little or no toxicity, but eight were toxic or very repellent to at least half the species when applied as dusts to foliage [*cf. R.A.E.*, A **29** 557]. Of these, three (acetophenone oxime, n-amyl carbamate and 2, 4-xylidene acetate) were volatile and evidently killed by fumigation, three were not effective when tested as stomach poisons in sprays, and two were effective as stomach poisons, but were very injurious to foliage.

Siegler (E. H.) & Gertler (S. I.). **Toxicity of Diaryl Trichloroethanes and Dichloroethylenes to Codling Moth.**—*J. econ. Ent.* **37** no. 6 p. 845, 3 refs. Menasha, Wis., 1944.

In view of the toxicity of 2, 2-bis (parachlorphenyl)-1, 1, 1-trichlorethane (DDT) to larvae of *Cydia* (*Carpocapsa*) *pomonella*, L. [*cf. R.A.E.*, A **32** 386], tests against them were carried out by the apple-plug method [*cf.* **23** 174] to compare it with five other diaryl trichlorethanes and two diaryl dichlorethylenes. The compounds were dissolved in ethanol (95 per cent.) and precipitated in water to give a concentration of 4 lb. per 100 U.S. gals. In the case of the diaryl trichlorethanes, substitution of bromine for chlorine in the benzene rings to give 2, 2-bis (parabromophenyl)-1, 1, 1-trichlorethane caused a decrease in toxicity. Compounds that contained either methoxy or methyl substituents (2, 2-di-p-anisyl- or 2 2-di-p-tolyl-1, 1, 1-trichlorethane) were highly toxic [*cf.* **33** 245], but the presence of the acetoxy group in the rings completely destroyed toxicity; the compound with no substituents in the rings showed considerable loss in effectiveness. The toxicity of the dichlorethylene derivatives was very low.

Scott (L. B.) & Milam (J.). **Gasoline to control Green June Beetle Larvae in Tobacco Plant Beds.**—*J. econ. Ent.* **37** no. 6 pp. 845–846. Menasha, Wis., 1944.

Larvae of *Cotinis nitida*, L., which often uproot tobacco seedlings by disturbing the soil surface [*cf. R.A.E.*, A **32** 422] and are only partly controlled by

Paris-green baits [*cf.* **31** 255, etc.], were controlled in preliminary tests in Tennessee in 1941–43 with petrol poured into holes 4–8 ins. deep and 18 ins. apart at the rate of 4–5 fl. oz. per hole. The holes were 2½ ins. in diameter, which is sufficiently large to keep the level of the petrol at least 2 ins. below the soil surface, thus decreasing the danger of injury to the roots of the seedlings, and were plugged with lumps of moist soil. The treatment appeared to be more effective in sandy loam than in clay covered with a three-inch layer of leafmould, and excessive soil moisture appeared to reduce its effectiveness. Counts made in excavated soil showed that about a third of the larvae were alive after treatment, but there was practically no surface activity,and plants would therefore probably not have been injured. Direct damage to the seedlings was avoided by applying the petrol well below the space occupied by the roots ; it evaporated rapidly and had apparently disappeared before the roots reached the treated soil. Only slight damage resulted when it was spilt on the seedlings and a slight yellowing of leaves was noted on occasional plants immediately adjacent to points of application, but no plants were killed.

In 1943 petrol was applied at the rate of 5 U.S. gals. per 100 sq. yards to a commercial tobacco plant bed that had been abandoned because of damage by *C. nitida*, but in this case the holes were made in the areas of heaviest infestation instead of at regular intervals. No insect damage or damage by the petrol occurred after treatment and a satisfactory crop was obtained.

CARTER (Walter). **A Striping of Pineapple Leaves caused by** *Pseudococcus brevipes*.—*J. econ. Ent.* **37** no. 6 pp. 846–847, 1 fig. Menasha, Wis., 1944.

Streaks of pale green to yellow, with a collapse of the water-storage tissue in the striped area, observed on a short section of each of 3–4 leaves of an inner whorl of field-grown pineapple plants in Hawaii was shown by experiments to be the result of feeding by *Pseudococcus brevipes*, Ckll. The mealybugs produced them whether or not they belonged to a strain that causes green spotting [*cf. R.A.E.*, A **30** 521–522]. No extension of the symptom beyond the area of mealybug feeding or other effect on the plant was observed, and progeny of affected plants showed no symptoms. The symptom is interpreted as non-systemic but affecting a local area rather than actual feeding points, and as a specific plant reaction to the complex insect secretion different from the two types of spotting [*cf.* **21** 64] and the systematic mealybug wilt [*cf.* **33** 249].

WOLFENBARGER (D. O.). **DDT for "out of place" Honeybee Colonies.**—*J. econ. Ent.* **37** no. 6 pp. 849–850, 2 refs. Menasha, Wis., 1944.

An account is given of the eradication of a colony of honey bees, apparently situated under the roof or in the eaves of a large two-storey house, which had proved impossible to destroy with carbon bisulphide or powdered calcium cyanide because it had three entrances and a long lead-in tunnel, and the brood nest could not be located. About 5 oz. of Gesarol A-20 Spray, a powder containing 20 per cent. DDT [2, 2-bis (parachlorphenyl)-1, 1, 1-trichlorethane], was blown into the entrances on each of three occasions, and six weeks after the first application the colony appeared to be eradicated. Its condition one week after the first application was such as to suggest that the subsequent ones may have been unnecessary. This material has the advantages of continued residual action, absence of fire hazard, safety to the occupants of the house and ease, thoroughness and safety of application.

STARR (D. F.). **The Theory of Probits at high Mortalities.**—*J. econ. Ent.* **37** no. 6 p. 850, 4 refs. Menasha, Wis., 1944.

The author provides evidence that the rigid application of the probit system in insect toxicology [*cf. R.A.E.*, A **22** 440] does not lead to hypothetical

impossibilities at mortalities above 99 per cent. [*cf.* **28** 491]. He also points out that lack of linearity in the mortality curve should be accepted as a clue to some difference in the mode of toxic action rather than as disproving the usefulness of probits.

CRESSMAN (A. W.). **Variations in the Susceptibility of California Red Scale to Oil Sprays.**—*J. econ. Ent.* **37** no. 6 p. 851, 1 ref. Menasha, Wis., 1944.

In laboratory tests in a settling-mist chamber, mortality of mature females of *Aonidiella aurantii*, Mask., from different *Citrus* groves [in California] that were treated with light medium oil varied considerably, and in field experiments, the same oil deposit caused 16 per cent. mortality in one grove and 95 per cent. in another. To determine whether such differences were inherent in scales from different sources, stocks from four groves that had shown different mortalities were reared under identical conditions in the laboratory and tested for comparative susceptibility to oil after several generations. The difference in kill of scales from two of the groves when treated with 0·75 or 1·25 per cent. light-medium oil was probably significant, but was small compared with those observed in field experiments, and no differences were found in the other tests. It is evident, therefore, that the larger part of the differences in mortality observed after field spraying or after laboratory spraying of scales collected in the field cannot be explained by genetic differences in susceptibility. The addition of derris resins to the oil did not cause any difference in mortality between different stocks. Mortality was much higher among scales on lemons that had shown a tendency to dry during the course of rearing than on lemons in good condition. There was no difference in mortality between scales 48 and 61 days old.

FULTON (R. A.) & MUNGER (F.). **The Effect of the Release of liquid HCN on Temperature under a Fumigation Tent.**—*J. econ. Ent.* **37** no. 6 pp. 851–852, 1 fig., 4 refs. Menasha, Wis., 1944.

In commercial *Citrus* fumigation the amount of liquid hydrocyanic acid used ranges from 18 to 24 millilitres per 100 cu. ft. Since the larger of these dosages would theoretically produce a drop of 8·1°F. in the air temperature within the tent at the time of release and temperature changes influence the kill of *Aonidiella aurantii*, Mask., temperatures were determined at several points within fumigation tents to measure the decrease caused by the rapid evaporation of the fumigant. A dosage of 24 ml. per 100 cu. ft. caused decreases in temperature within a duck tent of 1, 1 and 1·8°F. in three fumigations, and in another test, one of 20 ml. per 100 cu. ft. resulted in a decrease of 1·5° throughout the tent. In a gastight tent, with a dosage of 7 ml. per 100 cu. ft., a decrease of 0·5° was detected. This cooling effect is not sufficient to influence the kill of the scale, but obstructions such as leaves or branches directly in front of the atomiser and within 12–18 ins. of it cause condensation and the formation of solid hydrocyanic acid, which may reduce the concentration as much as 25 per cent. and lower the kill of the scales.

PIERCE (W. C.). **Cocooning Habits of Spring-brood Larvae of the Pecan Nut Casebearer.**—*J. econ. Ent.* **37** no. 6 pp. 852–853. Menasha, Wis., 1944.

In the course of investigations carried out in Texas in 1944 in pecan orchards moderately infested with *Acrobasis caryae*, Grote, 660 larvae were collected within tunnelled shoots during 19th–26th April, but only four pupae were found in the tunnels, and of 762 tunnelled shoots collected from 28th April to 16th May, 593 were empty, 137 contained living or dead larvae or parasites

and only 32 contained pupae. It is generally supposed that the larvae pupate in their tunnels, but about 50 cocoons were collected during May in crevices of the bark and under scales of rough bark, and cocoons were also observed attached to pecan shoots of the preceding year's growth, at the bases of the shoots and catkins of the current season's growth, on large branches, in pruning scars and in depressions formed by the decay of small lateral branches. The larvae and pupae in the cocoons were heavily parasitised, and some had been destroyed by predators, but about 25 moths were reared. Single individuals of two other species attacking pecan, *Gretchena bolliana*, Sling., and *Dichomeris ventrellus*, Fitch, were also reared from immature stages collected under scales of rough bark on the tree.

These observations show that some of the spring-brood larvae of *A. caryae* migrate from the new growth on which they have fed and form cocoons on other parts of the tree, and it is therefore possible that they can be trapped with the corrugated bands used for other insects with similar habits.

Hansen (E. L.), Hansen (J. W.) & Craig (R.). **The Distribution of a Bromine Homologue of DDT in Insect Tissue.**—*J. econ. Ent.* **37** no. 6 p. 853. Menasha, Wis., 1944.

The authors describe investigations in which dibromodiphenyltrichlorethane [2, 2-bis (parabromophenyl)-1, 1, 1-trichlorethane], which behaves similarly to DDT [2, 2-bis (parachlorphenyl)-1, 1, 1-trichlorethane] except for a slightly lower toxicity to insects, was prepared from the radioactive isotope of bromine and applied in the form of a saturated solution in cellosolve [ethylene glycol monoethyl ether] to the posterior thoracic tergites of adults of *Periplaneta americana*, L., and larvae of *Tenebroides mauritanicus*, L., *Tenebrio molitor*, L., and *Galleria mellonella*, L., at the rate of about 3·6 mg. for the cockroaches and 0·2–0·3 mg. for the larvae. Within 24 hours all the insects were very torpid or dead; they were washed in alcohol to remove the compound from the surface and dissected under dilute formalin. Portions of the organs were spread on slides, dried and covered with a celloidon film and then exposed to X-ray film for 250–360 hours. Almost all the tissues could be identified on the exposed film, and there was definite evidence that the compound was present in the nerve cord and brain as well as in other parts of the insect.

Fleck (E. E.). **Rate of Evaporation of DDT.**—*J. econ. Ent.* **37** no. 6 p. 853, 1 ref. Menasha, Wis., 1944.

To determine the rate at which DDT [2, 2-bis (parachlorphenyl)-1, 1, 1-trichlorethane] will evaporate from a dusted surface, a glass plate 50 sq. cm. in area with a deposit of 63·36 mg. DDT from a 325-mesh sieve was put in an air bath, for which a four-inch tube was used, and air was passed through at the rate of about 10 litres per hour. The temperature of the bath was kept at 45°C. [113°F.]. The plate was weighed every four days and it was found that the rate of evaporation was 0·34 mg. per day for the first four days and decreased during an observation period of 37 days until it was only 0·05 mg. per day, probably owing to a reduction in the surface area of the dust particles. A total of 4·22 mg. had evaporated by the end of 37 days, and the remainder was found to have a melting point identical with that of the original material. When the rate of air flow was varied from 5 to 20 litres per hour there was no corresponding change in the rate of evaporation. It is concluded that the loss of DDT from insecticidal spray deposits by evaporation will occur too slowly to be of any importance.

Muma (M. H.). **The Attraction of *Cotinis nitida* by Caproic Acid.**—*J. econ. Ent.* **37** no. 6 pp. 855–856. Menasha, Wis., 1944.

During tests of baits in traps for *Popillia japonica*, Newm., carried out in Maryland in the summer of 1942 [*cf. R.A.E.*, A **31** 488], numbers of adults of

Cotinis nitida, L., were found in traps containing technical caproic acid. There appeared to be equal numbers of males and females. In 1943, two traps containing this acid caught an average of 584 per trap from 28th June to 14th August and four caught an average of 100 per trap from 10th July to 14th August. In 1944, ten traps, five baited with caproic acid, diluted with an equal quantity of white mineral oil (viscosity 125–35 Saybolt) to reduce evaporation, and five unbaited, were arranged near a clump of wild grape and inspected every day from 24th June to 12th August. The five baited traps caught an average of 76·2 adults of *Cotinis* per trap and the empty ones an average of 2·4, and it is concluded that caproic acid definitely attracts this beetle ; the size of the funnel opening and the capacity of the container may require modification for greater efficiency of the traps.

HAEUSSLER (G. J.). **Obtaining freshly formed Codling Moth Pupae.**—*J. econ. Ent.* **37** no. 6 p. 856. Menasha, Wis., 1944.

When breeding pupal parasites of the oriental fruit moth [*Cydia molesta*, Busck] and the codling moth [*C. pomonella*, L.], freshly formed pupae of the former were readily obtained by incubating hibernating larvae that had been stored at 42°F. ; about 75 per cent. transformed to pupae on the sixth day when kept at 80° and a relative humidity of 70–80 per cent. Considerable difficulty was encountered in forcing hibernating larvae of *C. pomonella* to pupate, however, until the following technique was developed.

Hibernating codling moth larvae, trapped in late summer or early autumn in corrugated paper bands on apple trees, were removed from their cocoons and concentrated in batches of about 500 in packs composed of half-inch strips of white, semi-transparent, corrugated paper held together by rubber bands. The strips were placed together in such a manner that the only openings were those afforded by the corrugations, thus preventing the larvae from spinning between two strips, and the edges of the packs were strengthened by strips of waxed pasteboard. The larvae were confined with the empty packs at about 80°F. for 24 -48 hours to allow them to enter the corrugations and construct cocoons, and were then stored at 42° until needed. When removed from cool storage the packs were immersed in water for two hours and then kept in jars at 80°F. for several hours, frequently overnight, to allow the larvae to absorb moisture and to permit the excess water to drain off. While the paper was still moist, the strips forming the packs were separated and spread on paper towelling in a warm room, where they were left until the paper dried sufficiently to begin to stiffen. Some larvae migrated as the strips were drying, and these were collected and allowed to spin new cocoons in fresh strips of corrugated paper. After drying, the strips were kept at 80° and a relative humidity of approximately 80 per cent., and pupation usually began on the seventh or eighth day after removal from storage. By holding the individual strips up to the light, the cocoons containing pupae could readily be detected, and the sections containing them were cut out once every 24 hours ; approximately 10 per cent. of the cocoons were found to contain pupae at the end of each 24-hour period.

BARE (C. O.). **The Attraction of *Verbena bonariensis* to the Imported Cabbage Worm.**—*J. econ. Ent.* **37** no. 6 p. 856. Menasha, Wis., 1944.

Each season during 1934–39, adults of *Pieris rapae*, L., were observed feeding in great numbers on the flowers of a roadside weed, *Verbena bonariensis*, near Charleston, South Carolina, from late May to the middle of June. They were also seen to feed on cabbage and collard blossoms and on other wild flowers, but never in such large numbers, and it is considered probable that

the flowers of *V. bonariensis* contain some substance that could be used as a bait for them.

EBELING (W.), GUNTHER (F. A.), LADUE (J. P.) & ORTEGA (J. J.). **Addition of Extractives of Rotenone-bearing Plants to Spray Oils.**—*Hilgardia* **15** no. 7 pp. 675–701, 2 graphs, 26 refs. Berkeley, Calif., 1944.

The following is based on the authors' introduction and summary. The commercial use in southern California of oils containing extractives of rotenone-bearing plants for the control of Coccids on *Citrus* has emphasised several practical problems. These include the possibility of dissolving adequate concentrations of extractives in spray oils without the use of a mutual solvent; the passage of a toxic agent from the oil to the water phase of an emulsion; the effect of different types of mutual solvents on the physical nature and stability of the toxic solution, and on the insecticidal effectiveness and oil-depositing properties of the spray; decomposition of the toxic agent during the varying periods between manufacture and use; the relative value of rotenone, rotenone-free extractives and total extractives; and the long-term effect on the scale population resulting from the lighter oils, which are made more effective by the addition of a toxic agent, but do not leave a long-lasting film of oil on the tree to retard the development of the progeny of surviving scales. The purpose of this paper is to evaluate the relative importance of these and other incidental factors and to suggest means by which present difficulties may be overcome.

It was found that powdered extractives can be dissolved directly in spray oil at room temperature in concentrations of insecticidal value by mixing the powder in oil for 20 minutes; in the same manner the extractives can be obtained from finely divided plant material. In either case, an emulsive oil was a better solvent than straight oil of the same grade, but to obtain the highest concentrations in oil it was necessary to use mutual solvents. A solubiliser is defined as a mutual solvent of which a very dilute concentration, usually 1 per cent. or less, will produce a thermo-dynamically stable colloidal aqueous or nonaqueous solution of otherwise insoluble or only slightly soluble substances. The term oleotropic solvent is proposed for mutual solvents that, when added to an oil in large amounts, will increase the solubility of an otherwise insoluble or slightly soluble substance in oil merely by adding their solvent properties to that of the oil. No rotenone plus deguelin passed from the oil to the water phase of a mixture of oil and water that was agitated for 45 minutes when the extractives were in true solution in the oil, but a colloidal solution of extractives in oil may lose from one-fourth to one-third of its rotenone plus deguelin content under the same conditions. Cardolite 627 [*cf. R.A.E.*, A **31** 491] is a highly efficient solubiliser for incorporating derris extractives in spray oil, forming a visually clear, stable solution that is probably mainly colloidal [*cf.* **32** 220]; but a slightly cloudy solution is formed when 5 per cent. derris extractives in *n*-butyl phthalate, a good oleotropic solvent, is added to spray oil (1 : 7). Nevertheless, an oil spray with an optimum concentration of derris extractives brought into partial solution in the oil by means of *n*-butyl phthalate is far more effective against the California red scale [*Aonidiella aurantii*, Mask.] than an oil spray used at the same strength and containing the same concentration of derris extractives but having Cardolite 627 as a solubiliser. The increase in the effectiveness of the oil due to the addition of a solution of extractives in *n*-butyl phthalate is brought about despite a reduction in the amount of oil deposited on the tree surface by the emulsifying effect of the mutual solvent [*cf.* **32** 220]. It is assumed that the greater effectiveness of the solutions containing oleotropic solvents results from the fact that the molecules of the extractives are mainly in molecular solution, in which condition they are probably more effective against insect

tissue than when they are bound within the colloidal particles resulting from the use of a solubiliser. Moreover, as stated above, a substantial proportion of the colloidal particles will pass from the oil to the water phase of an agitated spray mixture.

Freshly prepared solutions of extractives in Cardolite and kerosene were highly effective against *A. aurantii* when the concentration of total extractives in the kerosene was 0·103 per cent. (0·031 per cent. rotenone). There was considerable decomposition of the toxic solution in six weeks, but this can be minimised by the addition of an antioxidant.

An adequate concentration of derris or cubé extractives can be obtained merely by soaking ½ lb. finely ground root in 10 U.S. gals. kerosene for 20 minutes ; this results in a total concentration of 50 mg. rotenone plus deguelin per 100 ml. kerosene. The finely ground root also increases the effectiveness of regular oil sprays when added at the rate of 4 oz. per U.S. gal. oil. Continuous stirring of ground cubé root in emulsive spray oil for 20 minutes results in the maximum degree of extraction of the toxic ingredients from the root particles, and, if such a procedure were carried out, it is probable that the ground root soaked directly in the oil would afford the most effective practicable means of using this product with spray oil against *Citrus* pests, since the extracted toxic constituents of the root are entirely in true molecular solution, and have therefore their greatest possible insecticidal value ; the danger of foliage injury or reduction in oil deposit such as may be caused by a mutual solvent is eliminated ; and the method is the most economical known of incorporating derris or cubé extractives into spray oil. The toxic ingredients of derris root are not so readily extracted by spray oil as those of cubé root.

When added to spray oil, the rotenone-free extractives (deguelin concentrate) of derris appear to be about as effective as rotenone if at the same concentration. The complete extractives, however, are more effective than equal concentrations of either rotenone or the rotenone-free extractives used by themselves, and it is evident that these are synergistic. When added to kerosene, the rotenone-free extractives were not so effective as the rotenone, even though the latter was necessarily used at a lower concentration : neither were they so effective as the total extractives when used at the same concentration.

It is possible that the best mutual solvents, from the standpoint of insecticidal effectiveness, will not be suitable for preparations of spray oils with toxic agents because a certain percentage of solids may precipitate on standing. If this should be the case, it is suggested that the mutual solvents and extractives be prepared in a separate solution to be added to the oil just before it is poured into the spray tank.

An oil film on the tree, impeding the settling and development of crawlers issuing from scales not killed by an oil spray, was demonstrated to influence the effectiveness of the treatment markedly nine months after spraying by comparison of the effects against *A. aurantii* of toxic agents in light-medium oil and in kerosene, which leaves no oily residue because of its rapid penetration and evaporation. However, when the initial percentage kill from a spray of toxic agent in kerosene was sufficiently high (99·5), it more than offset the lack of oily residue, and resulted in trees more free of infested lemons after an interval of nine months than the regular light-medium spray oil with or without a toxic agent.

GRISWOLD (G. H.). **Studies on the Biology of the Webbing Clothes Moth (*Tineola bisselliella* Hum.).**—*Mem. Cornell agric. Exp. Sta.* no. 262, 59 pp., 24 figs., 6 pp. refs. Ithaca, N.Y., 1944.

The following is based on the author's summary. *Tineola biselliella*, Humm., is widely distributed in the United States and throughout the world, and the

larvae cause serious damage to furs, woollen clothing, upholstered furniture, carpets and other household furnishings. Living insects for laboratory studies on its bionomics were obtained from infested woollens or reared on fish-meal in cylindrical cardboard cartons ; at least one new colony was started each month, as this species will not breed continuously in the same container.

The duration of the egg stage was found to depend on temperature rather than on humidity. It averaged 37·23 days at 55°F., 13·79 at 65°, 6·69 at 75°, and 5·19 at 85° ; at 55, 75 and 90°, it was about as long under dry as under moist conditions. To test various diets, newly hatched larvae were placed in individual vials, each with a particular kind of food. Of the 2,300 used, 1,017 (44·22 per cent.) became full-grown and pupated. Fish-meal was the most satisfactory food tested, but many larvae completed their growth on ground fish scales, ground salmon eggs, dried insect specimens, patent flour and various kinds of fur, hair and feathers. Some developed to the pupal stage on casein, ground egg albumen and powdered blood serum, but none did so on granulated gelatine, raw silk or clean woollen fabrics [*cf. R.A.E.*, A **29** 376]. When flannel was rubbed with suet or egg yolk, its nutritional value was not improved ; on woollen jersey soiled by perspiration, one larva out of 25 completed its growth and pupated. The length of larval life was found to depend primarily on diet. Of 30 individuals reared to the adult stage on fish-meal at 75°F. and a relative humidity of 75 per cent., the males spent approximately 30 days as larvae and the females approximately 35 days ; for individuals reared on some of the other foods, the larval life often lasted more than a year, and one male remained in the larval stage for more than two years. To ascertain the number of instars, newly hatched larvae were allowed to complete their development in individual vials containing white rat fur, and, as soon as an adult emerged, the cast head capsules in the vial were removed, measured and counted. The number of instars was closely correlated with the duration of development ; eight males and one female that developed in 54–59 days all had five instars, but a male that took 237 days to develop had twelve. The larva usually spins a tough, parchment-like cocoon, sealed at both ends, when ready to pupate. Data on the duration of the pupal stage were obtained from individuals that spun their cocoons against glass, so that the insects within the cocoons could be kept under constant observation. The pupal stage lasted 49–54 days at 55°F., 22–23 days at 65° and 11–13 days at 75° for males, and about the same for females.

The period required for complete development (newly laid egg to adult) and the percentage of emergence depended primarily on the larval diet, but also on temperature and humidity. The development periods of more than 1,000 individuals varied from 36 to 780 days ; when the larval diet was fish-meal, they were uniformly short, and somewhat shorter for the males than for the females. They often varied greatly in the case of individuals reared on some of the less satisfactory foods, even when these individuals came from eggs laid by a single female on the same day. At 25°C. [77°F.] and on a larval diet of fish-meal, the percentage of emergence was higher under moist than under dry conditions. The development periods varied from 39 to 50 days at 75 per cent. humidity, and from 54 to 78 days at 20 per cent. At 75°F. and on a larval diet of feathers, 18 of 75 individuals were reared to the adult stage at 75 per cent. humidity and 9 of 75 at 20 per cent. Although the individuals reared at 75 per cent. humidity had development periods of 66–408 days, nine completed their development in less than 90 days. At 20 per cent. humidity, one completed its development in 121 days and the remainder in 200–285 days.

Of 1,012 adults reared in individual vials from the egg stage, 480 were males and 532 females [*cf. loc. cit.*]. Mating took place shortly after emergence, and some females began to oviposit in less than 24 hours at both 65 and 75°F., though a few had pre-oviposition periods of 7–8 days. Experiments showed that females will mate and lay eggs, some of which will give rise to adults, during any month of the year. The oviposition period averaged 17·11 days

at 65°F. and 11·38 days at 75°. The total number of eggs laid by a single female varied from 25 to 119 at 65°F. and from 29 to 144 at 75° ; the largest number laid by a female in one day was 57. Many females died in less than 24 hours after egg-laying ceased, but some lived 8 days at 65°F. and 3 days at 75°. Among both paired and unpaired individuals, the males lived longer than the females. Paired males and females lived 5–61 and 12–39 days at 65°F. and 10–45 and 6–22 days at 75°. Unmated males and females reared on fish-meal had adult lives of 26–44 and 10–32 days at 75°F. and 75 per cent. humidity.

The Braconid, *Apanteles carpatus*, Say, was the only parasite reared from *T. biselliella* at Ithaca (New York). Larvae of the Dipterous predator, *Scenopinus fenestralis*, L., were seen to attack larvae of *Tineola*, and predacious Gamasid mites were sometimes troublesome in the colonies.

Smith (R. H.). **Insects and Mites injurious to Sycamore Trees (*Platanus* spp.) in western North America.**—*Arborist's News* **9** no. 2 pp. 9–15, 6 figs. Wooster, Ohio, 1944.

Species of *Platanus* are widely planted in the western United States as shade and ornamental trees, but are more susceptible to attack by insects and mites under cultivation than in a wild state. The introduced *P. orientalis* is more susceptible than the native species (*P. occidentalis*, *P. racemosa* and *P. wrightii*) ; *P. acerifolia* is regarded as a hybrid between *P. orientalis* and *P. occidentalis* and exhibits a wide range of susceptibility.

The mites that damage the foliage of *Platanus* spp. in this region are *Tetranychus bimaculatus*, Harvey, *T. pacificus*, McG., *T. willamettei*, McG., *T. sexmaculatus*, Ril., *Paratetranychus pilosus*, C. & F., *P. coiti*, McG., *P. ilicis*, McG., and the Eriophyid, *Rhyncaphytoptus platani*, Keifer. *T. sexmaculatus* shows a marked preference for *Platanus acerifolia* and *P. occidentalis*, particularly the former, on which it is very common in the coastal belt of California. It is often practically confined to these species in plantations containing also *P. orientalis* and *P. racemosa*. *Paratetranychus ilicis* occurs on almost all species of *Platanus* throughout California and may cause all the leaves on infested trees to become brown on the upper surface. The females overwinter on vegetation surrounding the trees. *Rhyncaphytoptus platani* is often fairly abundant on the lower surface of leaves of *P. orientalis* in California. It apparently overwinters beneath the bud scales and increases rapidly in spring and early summer on the young leaves, where its feeding is believed to cause the russeting often observed on the lower surface. Later in the year, it occurs in small groups scattered over the leaves. All these mites can be controlled by the prompt application of summer oil.

The most injurious of the Coccids is *Stomacoccus platani*, Ferr., which is very destructive to *P. orientalis* and a minor pest of other species in California [*R.A.E.*, A **31** 135] ; it also occurs in western Arizona and northern Mexico. Many of the young that hatch towards the end of the summer and most of those that hatch in late autumn remain in the first instar until January, when development again begins and is completed by the end of the month. During February, adults of both sexes occur on the bark and the females oviposit under the bark plates, each depositing about 90 eggs. The young hatch soon after the leaf buds unfold and settle on the lower surface of the leaves, which become deformed. Three weeks later, when this generation has completed its development, the leaves are flecked with necrotic spots and soon fall. The adults move to the bark and oviposit under the plates. The second generation hatches in about a fortnight and develops on the young terminal leaves produced since the first was present, causing them to be malformed. A third generation settles on the bark and on the leaves, principally the petioles, midribs and larger veins. The leaves are fully developed and do not become malformed, but are weakened and fall. This defoliation continues during the summer and autumn. The four immature instars of the female are briefly

described. A single application of a dormant oil spray in the first half of January, before development is resumed, gives adequate control [*loc. cit.*]. *Stomacoccus capsulatus*, Ferr., which was described on *P. wrightii* in Arizona in 1941, resembles *S. platani* in bionomics, but has not been recorded in California. Other Coccids that may injure nursery stock and young trees are *Quadraspidiotus* (*Aspidiotus*) *perniciosus*, Comst., *Q.* (*A.*) *juglans-regiae*, Comst., *Lepidosaphes ulmi*, L., *Pulvinaria vitis*, L., *Coccus hesperidum*, L., *C. elongatus*, Sign., *Eulecanium* (*Lecanium*) *excrescens*, Ferr., *E.* (*L.*) *pruinosum*, Coq., and *E.* (*L.*) *corni*, Bch. They can all be controlled by dormant oil sprays applied in late winter.

The only Aphid of any importance on *Platanus* is *Drepanosiphum platanoides*, Schr., which sometimes occurred in the coastal regions and also attacks maples. Jassids, of which six species are concerned, may be so abundant as to cause nearly all the leaves to become discoloured, brittle and unsightly by reason of the excrement covering their lower surface. The best control measure is the use of dormant oil to destroy the over-wintering eggs at the base of the unopened buds. The scars made by ovipositing Membracids sometimes injure the smaller branches, causing them to break readily in windy weather, but serious damage is generally confined to a few trees. Dormant oil sprays give fair control of the eggs. *Corythucha confraterna*, Gibson, is prevalent on *Platanus* spp. throughout the Pacific Coast region, Utah, Arizona and New Mexico, and *C. ciliata*, Say, occurs on them in the Rocky Mountain States. These Tingids overwinter under the bark or in débris near the trees and move on to the leaves in spring, where they form colonies on the lower surfaces. All the leaves may be damaged in late summer. Pyrethrum and rotenone sprays give fairly good control, but the adults drop from the trees when disturbed and many therefore escape the insecticide. The type of injury associated with *Plagiognathus albatus*, Van D. [**32** 387] has been noted on infested trees in Kansas and Iowa, but it has frequently been observed on trees in California on which this Capsid was not present, and it is therefore not regarded as the only cause.

The leaf-mining larvae of *Lithocolletis felinelle*, Heinr., are sometimes very abundant on *Platanus racemosa* and also occur on other species. There are several generations a year, and parasites periodically exert control. Nicotine sprays are effective against the larvae. On the Pacific Coast, other Lepidopterous larvae, of which *Gelechia desiliens*, Meyr., is the most important, injure the young leaves and the tips of the branches of all species of *Platanus*. The larvae of *G. desiliens* which are injurious from early spring until mid-summer, eat through the upper surface of the leaves and shelter under the pubescence on the lower surface; terminal leaves may be folded or tied together. *Aegeria* (*Synanthedon*) *mellinipennis*, Boisd., is a serious pest of *Platanus* in California and also occurs in Colorado. The adults emerge in early summer and the females oviposit on the bark, especially in the crotches of the main branches. The larvae bore in the inner bark and may completely girdle large branches or even the trunk below the main branches. Infested trees are stunted and abnormal proliferations of tissue are produced in the crotches. Control comprises scraping off the rough bark and applying a thin dressing of a mixture of paradichlorbenzene and pruning compound (1 : 15) in late summer or autumn to destroy the larvae.

Hawboldt (L. S.). **History of Spread of the Beech Scale, *Cryptococcus fagi* (Baerensprung), an Insect introduced into the Maritime Provinces.**—*Acadian Naturalist* **1** no. 4 pp. 137–146, 2 maps, 15 refs. Fredericton, N.B., 1944.

The author describes and illustrates on a map the westward spread of *Cryptococcus fagi*, Baer., on beech in the Maritime Provinces of Canada from 1890 to

1942 [*cf. R.A.E.*, A **22** 393 ; **32** 327] and discusses some of the factors governing its dispersal and its effect on beech there. It has also been observed in the United States, in Maine, New Hampshire, Massachusetts, Connecticut and New York [*cf.* **30** 174]. Reproduction is parthenogenetic, and there is one generation a year [*cf.* **22** 394]. The eggs are deposited in summer and the young sometimes crawl considerable distances over the tree before settling. A light infestation causes no appreciable injury, but a heavy one results in the death of patches of bark and sometimes of the cambium. A fungus (*Nectria* [*coccinea*]) invades areas where the scale has been feeding in large numbers and assists in killing trees and causing scars [*cf.* **22** 497]. Ways in which the Coccid has been spread are briefly reviewed [*cf.* **22** 394] ; factors that are considered to have favoured its dispersal are that stands of beech are common in the Maritime Provinces ; that it multiplies rapidly ; that it is not adequately controlled by natural enemies, though it is attacked by several predators, particularly *Chilocorus stigma*, Say (*bivulnerus*, Muls.), and attempts to establish more effective predators from Europe have proved unsuccessful ; and that although it is apparently favoured somewhat by a coastal climate, it can withstand the more severe winter conditions of the interior.

Annual Report of the Forest Insect Survey . . . 1943.—68 pp., 18 maps. Ottawa, Dep. Agric. Canada, 1944.

Owing to wartime conditions, important changes were made in the organisation of the Forest Insect Survey of Canada in the course of 1943. The reports for the different regions are now given separately and contain much more detail than the inclusive reports of previous years [*cf. R.A.E.*, A **32** 22]. L. S. Hawboldt deals with the Maritime Provinces and Newfoundland (pp. 5–17, 6 maps), R. Lambert with Quebec (pp. 18–31, 1 map), C. E. Atwood with the greater part of Ontario (pp. 32–45, 4 maps), H. A. Richmond and D. N. Smith with the forest area of the Prairie Provinces and far western Ontario (pp. 46–55, 2 maps), L. Peterson with the agricultural area of the Prairie Provinces (pp. 56–61, 4 maps), and H. B. Leech with British Columbia and western Alberta (pp. 62–68, 1 map). Notes are given on the status of major insect pests of forest and shade trees, including species causing serious injury during 1943 except in the case of the agricultural area of the Prairie Provinces, where none was recorded, and those not causing injury at the time but known to be capable of doing so, and also on the status of minor or local pests. The report from Ontario includes, in addition, records of beneficial insects and of insects attacking the men in lumber camps.

Simmonds (F. J.). **Observations on the Parasites of *Cydia pomonella* L. in southern France.**—*Sci. Agric.* **25** no. 1 pp. 1–30, 5 figs., 8 refs. Ottawa, 1944.

In view of the severity of infestation of apples by *Cydia pomonella*, L., in the warmer parts of Canada, particularly Ontario, and the desirability of importing parasites against it, a study of its parasites in France was begun in 1939. The work was carried out chiefly in the mountainous districts of the Department of Var, where parasitism was higher than that recorded by Rosenberg in northern France [*cf. R.A.E.*, A **22** 491] and where there is a great range of climatic conditions. It was broken off in June 1940, and the results so far obtained are given and discussed.

Apples collected during the summer of 1939 were cut up, and all young *Cydia* larvae in them dissected to determine the percentage parasitism and the parasite species present ; infested apples were also kept so that adult parasites could be reared from the *Cydia* larvae. Single larvae of *Ascogaster quadridentata*, Wesm., were found in 33·1 per cent. of the young *Cydia* larvae, and 1–2 eggs

or larvae of *Pristomerus vulnerator*, Panz., which sometimes occurred in hosts already containing larvae of *Ascogaster*, in 6·4 per cent. ; and planidia of the hyperparasite, *Perilampus tristis*, Mayr, occurred in 3·7 per cent., including unparasitised larvae, in which they do not develop, and those containing *Ascogaster* and *Pristomerus*. The total percentage parasitism by the primary parasites was 37·5, and all three species were present in first-instar larvae. These species and *Trichomma enecator*, Rossi, were also reared from fully fed larvae that emerged from the fruit : in this case the total percentage parasitism was 31·6. In a test with one tree, the quarter facing south-west was more heavily attacked by *C. pomonella* than the rest, and the larvae in the south-east lower part were more heavily parasitised than the remainder, and in tests with two varieties of apple, although insufficient parasites were reared to show whether there was a significant difference in parasitism between the two, there was considerable difference between the percentages of larvae that entered diapause, suggesting that the quality of the food influences this tendency.

To investigate the parasites that attack the larvae within their cocoons, a large number of apple trees, some pears, quinces and walnuts and a few plums, almonds and chestnuts were banded with corrugated cardboard before the end of August. The bands were removed during September, October and November, and, at the same time, these and other trees were examined for hibernating larvae. On smooth-barked trees a high proportion of larvae formed their cocoons in the bands, but when the bark was much fissured, the majority chose the bark itself. Most of the material collected remained in hibernation until the following spring, but some parasites, comprising the Braconid, *A. quadridentata*, the Ichneumonids, *P. vulnerator*, *T. enecator*, *Ephialtes caudatus*, Ratz., and *Cryptus sexannulatus*, Grav., the Pteromalids, *Dibrachys cavus*, Wlk., and *D. affinis*, Masi, and the Eulophid, *Melittobia acasta*, Wlk., emerged in the same year ; hyperparasites were *Hemiteles* spp., from *Cryptus* and *Ephialtes* sp., *D. cavus* from *Cryptus*, *Ascogaster* and *Pristomerus*, and *Perilampus tristis* from *Ascogaster* and *Pristomerus*. The hibernating material was kept in an outhouse until February, when some was transferred to a constant temperature of 25°C. [77°F.] in order to hasten emergence. The adults that emerged were removed each day and recorded. They comprised the same parasites and hyperparasites as before, with the exception of *M. acasta*, and also *E. crassiseta*, Thoms., *E. ruficollis*, Grav., *E. cydiae*, Perkins, a species of *Meteorus*, possibly *M. chrysophthalmus*, Nees, and *Elodia* (*Arrhinomyia*) *tragica*, Mg.

The sequence in which the parasites emerged was the same in both lots, but emergence at the constant temperature began at the beginning of March, about six weeks earlier than under natural conditions. Some of the hibernating larvae of *Cydia* were much smaller than others, and mortality was much higher among the small individuals ; in material taken from quince in the hot coastal regions, only 215 individuals emerged from 637 small cocoons, and of these, 2 were *Cydia*, 68 *Anarsia lineatella*, Zell., which may also have served as a host, 112 *Ascogaster*, 18 *Pristomerus* and 15 *Perilampus*, whereas 714 emerged from 915 large cocoons, 577 being *Cydia*, 115 *Pristomerus* and 22 *Perilampus*. It appears therefore that larvae parasitised by *Ascogaster* are still comparatively small when they enter hibernation, whereas those parasitised by *Pristomerus* tend to reach the normal size, and that only a very small proportion of the small larvae give rise to adults. In the material kept under natural conditions, *Hemiteles* spp. emerged earlier than the rest, and the other parasites, with the exception of *Ascogaster* and *Perilampus*, emerged well before *Cydia* ; *Ascogaster* began to emerge somewhat after the host, and *Perilampus* was the last to emerge. The numbers of ectoparasite cocoons and larvae collected indicated a percentage parasitism of 2·8 by *Ephialtes*, 1·4 by *Cryptus* and 0·4 by *Dibrachys*, but there is some further parasitism of the hibernating generation by the parasites that emerge from it in spring.

Little difference was found in the composition of the parasite complexes associated with apple, pear or quince, except that *E. ruficollis* was found only on quince ; from larvae in bands on walnut trees, the same parasite species were obtained, but the percentages of *Trichomma* and *Cryptus* were higher. No differences due to locality or to climatic variation in the mountains were observed. Various possible predators, including *Tenebroides mauritanicus*, L., *Dolichosoma lineare*, Rossi, species of *Cantharis*, *Malachius* and *Mecynotarsus*, and the mite, *Pediculoides ventricosus*, Newp., were taken in the bands and under the bark ; these were useless against *Cydia* cocoons in the laboratory, and the value of insect predators in controlling the moth in the south of France appears to be negligible. In many places, the full-grown larvae were destroyed by birds and lizards, and many larvae in cocoons were attacked by fungous and polyhedral diseases.

The second half of the paper consists of notes on the life-history of the various parasites and hyperparasites obtained, including some laboratory observations, and an estimate of the effect of parasitism throughout the year on *Cydia pomonella* in southern France. As a result of the work, it was considered desirable to introduce *Pristomerus*, *Ephialtes* and *Cryptus*, with, if possible, *Trichomma*, *Elodia* and *Meteorus*, into Canada, and a small shipment of *C. sexannulatus* and *E. caudatus* was made. Both species were reared in the laboratory [*cf.* **30** 112] and liberated in the Niagara peninsula in Ontario.

It is stated in the course of the paper that subsequent examination has shown that the material recorded by Rosenberg [**22** 491] as *Ephialtes extensor*, Taschb. [which is a synonym of *E. punctulatus*, Ratz.] consisted of *E. caudatus* and *E. crassiseta* [*cf.* **28** 226], and that Rosenberg's specimens of *Perilampus* consisted solely of *P. tristis* and not, as he thought, of *P. tristis* and *P. laevifrons*, Dalm.

André (M.). **Sur le *Bryobia praetiosa* Koch (Acarien).**—*Bull. Mus. nat. Hist. nat.* (2) **13** nos. 4–5 pp. 259–265, 430–434, 42 refs. Paris, 1941. [Recd. 1945.]

Descriptions are given of all stages and of the developmental cycle of *Bryobia praetiosa*, Koch, together with notes from the literature on its synonymy and habits. It was taken on pear in June 1937 in a locality in the Grand Atlas, Morocco, and was reported to have caused considerable damage there to almond. The eggs overwintered and hatched towards the end of March, and the mite passed through a larval and two nymphal stages, each of which was followed by a resting stage. These various stages each lasted 3–6 days. The larvae fed on the young leaves at the ends of the twigs, and the adults emerged at the beginning of June. They were present until the middle of the month and oviposited on the bark of the trees, on lichen on the bark and on old buds. There was only one generation a year.

Hovasse (R.). **Le pou de San-José menace les arbres fruitiers de l'Auvergne.**—*Rev. Sci. nat. Auvergne* (N.S.) **7** fasc. 3–4 pp. 123–129, 3 figs. Clermont-Ferrand, 1941. [Recd. 1945.]

Despite precautions to prevent its entry [*cf. R.A.E.*, A **25** 106], *Quadraspidiotus* (*Aonidiella*) *perniciosus*, Comst., has recently become established in France. It has been found near Cannes in the Alpes Maritimes [*cf.* next abstract] in Vaucluse and in the district of Lyons, where it occurred over a considerable area in October 1940.

This Coccid attacks almost all the deciduous fruit trees grown in France, and in view of its potential importance there, an account is given of its life-history and measures for its control.

André (M.). **Sur l'*Hemisarcoptes malus* Shimer (=*coccisugus* Lignières) (Acarien).**—*Bull. Mus. nat. Hist. nat.* (2) **14** no. 3 pp. 173–180, 2 figs., 33 refs. Paris, 1942. [Recd. 1945.]

A mite found attacking *Quadraspidiotus* (*Aonidiella*) *perniciosus*, Comst., in orchards in a locality in Alpes-Maritimes [*cf.* preceding abstract] has been identified by the author as *Hemisarcoptes malus*, Shimer (*coccisugus*, Lign.). It had previously been known to attack *Lepidosaphes ulmi*, L., and other Coccids on fruit trees in the United States [*cf.* **20** 65] and various parts of Europe, including Germany [*cf.* **8** 468]. Its identity, systematic status and habits and those of *Thyreophagus* (*Monieziella*) *entomophagus*, Lab., are reviewed from the literature, and characters are given distinguishing them from each other. *T. entomophagus* infests drugs and other stored products of animal or vegetable origin [*cf.* **26** 95] and has been recorded as attacking *L. ulmi* in the United States and Europe, though in the latter case it was apparently feeding on dead examples.

Parrot (A. G.). **Envahissement progressif de la région de Bayonne-Biarritz par la cochenille australienne : *Icerya purchasi* Mask.**—*Bull. Mus. nat. Hist. nat.* (2) **16** no. 3 pp. 176–178. Paris, 1944.

Icerya purchasi, Mask., occurs in Provence, where the Coccinellid, *Rodolia* (*Novius*) *cardinalis*, Muls., has been introduced for its control, and in 1938 the author observed it in Biarritz, where it was spreading rapidly. Its chief food-plant there appeared to be *Acacia dealbata*, but species of *Pittosporum* and *Tamarix* were infested and sometimes killed by it, and numerous other plants, including *Citrus*, hedges of *Euonymus* and privet (*Ligustrum*), and oak and other trees, were more or less severely attacked. It also occurred on herbaceous plants and even on mosses and potato. It is not known how or when it was introduced into the district, but it has spread from it as far as Bayonne, its dispersal to the westward being due presumably to the prevailing wind. The only means of checking its advance is to establish fresh centres of multiplication of *R. cardinalis*.

García Mercet (R.). **Los parásitos de los insectos perjudiciales.** [Parasites of injurious Insects.]—$8\frac{1}{4}\times5\frac{1}{4}$ ins., vii+153 pp., 39 figs., $2\frac{1}{2}$ pp. refs. Barcelona, Salvat Edit., S.A., 1932. Price *Ptas.* 11. [Recd. 1945.]

The introductory sections of this book on the use of parasitic insects for the control of insect pests include discussion of parasitism, hyperparasitism and superparasitism, descriptions of the various methods of rearing laboratory stocks of parasites, and the general characters and bionomics of the principal families to which insect parasites belong, together with descriptions of genera that are important in Spain. They are followed by eleven sections containing information on the bionomics, distribution, morphology and method of utilisation of native and introduced parasites of several pests of major importance on crops and forest trees in Spain, arranged according to the hosts, which make up rather more than half the book. In some cases brief notes on hyperparasites are included. A concluding section contains a discussion of the difficulties and risks that attend the introduction of parasites from other countries, and lists of parasites of a number of common pests that attack agricultural crops and forests in Spain.

Frazer (H. L.). **Observations on the Method of Transmission of Internal Boll Disease of Cotton by the Cotton Stainer-bug.**—*Ann. appl. Biol.* **31** no. 4 pp. 271–290, 1 pl., 5 figs., 2 graphs, 57 refs. London, 1944.

A detailed account is given of investigations on the method of transmission by *Dysdercus* spp., of *Nematospora gossypii* and allied fungi that cause internal boll disease of cotton. The literature on the subject is reviewed, and descriptions are given of the feeding mechanism of *Dysdercus* and the process of moulting

of the nymph with special reference to it. Information was obtained by microscopic examination of insects that had been exposed to infected material; by re-isolation of the fungus from various parts of insects thought to be infected; and by demonstrating the infectivity of insects known to have had access to cultures of *Nematospora*. The observations showed that the spores were ingested with food material and reached the intestine, where they did not germinate, and the stylet pouches, where they did. They apparently reached the pouches by leakage during feeding, and the insects became infective immediately after feeding on infected material. The fungus appeared to be ejected in the same way, but the form in which it was ejected was not ascertained. Observations also showed that infection of plants occurred entirely at random, and supported the view that ejection of the fungus is by chance. Spores were not found in first-instar nymphs, which do not feed, or, when all sources of re-contamination were removed, in the stylet pouches of insects that had just moulted, and though they were retained in the intestine after moulting, there was no evidence that they remained viable. In nature the chief sources of re-contamination are infected fruits and seeds of cotton or alternative food-plants, but exuviae and perhaps also extra-floral nectaries could harbour the fungus. The insect and the fungus can develop independently and there was no evidence that the fungus enters the living tissues of the insect, which is apparently unharmed by it. No alternative morphological form of *N. gossypii* within the insect was found. The distribution and behaviour of the fungus within the insects was confirmed by examination of specimens from natural sources in Nyasaland.

Jacob (F. H.). **A two Years' Survey of the Potato Aphides in the Northern Agricultural Advisory Province.**—*Ann. appl. Biol.* **31** no. 4 pp. 312–319, 1 map, 25 refs. London, 1944.

A survey of populations of potato Aphids was carried out in 1942–43 in Cumberland, Westmorland, Northumberland and Durham, where certain areas have proved suitable for the production of high-grade (virus-free) seed potatoes and considerable variations in climatic and other factors exist. In 1942, farms were visited in widely separated parts of the area in order to gain a general knowledge of the distribution of the Aphids, and during the winter of 1942–43 winter food-plants were examined. In 1943, farms were chosen in each of the four counties, mainly for their proximity to areas in which seed potatoes are grown and winter food-plants, particularly savoy cabbage and *Rhamnus* spp., occur. The potato crops on the farms were inspected one or more times in 1942 and three times in most cases in 1943, and the numbers of *Myzus persicae*, Sulz., *Macrosiphum solanifolii*, Ashm., *M. solani*, Kalt. (*Myzus pseudosolani*, Theo.) and *Aphis rhamni*, Boy., per 100 leaves at each inspection and the percentages of leaves infested by each species are shown in tables.

In the mild winter of 1942–43, hibernation of *Myzus persicae* on savoys as apterous and alate viviparae was apparently widespread; small numbers were found on other cruciferous vegetables. Numerous apterous viviparae of *Macrosiphum solanifolii*, overwintered on *Rumex obtusifolius*, and in spring this Aphid was not uncommon on strawberry. No eggs of *Aphis rhamni* were found during the winter, and no colonies were seen in spring on *Rhamnus cathartica*, its winter food-plant. Apterous viviparae of *M. solani* overwintered on foxglove (*Digitalis purpurea*), particularly in the western part of the area; neither sexuales nor eggs were found on this plant. The winter of 1943–44 was similar to that of 1942–43, and *Myzus persicae*, *Macrosiphum solani* and *M. solanifolii* all overwintered as apterous viviparae in considerable numbers; eggs of *A. rhamni* again could not be found. Based on data from two meteorological stations, the numbers of days during May, June and July in the years 1929–43 on which conditions were suitable for the flight of *Myzus persicae* [*cf.*

R.A.E., A **29** 180] are shown in a table. Winter data at each station suggested that severe conditions were unusual and that *M. persicae* could have overwintered successfully on savoys in all but four winters in the period 1928–43.

The initial infestations of *M. persicae* and *Macrosiphum solanifolii* on potato were greater in 1943 than in 1942, when the slow development of the peak population of each species was probably correlated with the low initial infestations. They did not develop as quickly in 1943 as might have been expected from a study of the overwintering data and the fairly general infestation in June, probably as a result of the cool wet summer. The greatest populations of both Aphids occurred in close proximity to urban areas, where market and kitchen gardens and allotments favoured their incidence, but few high populations were recorded. The incidence of *A. rhamni* showed a marked correlation with the distribution of its winter food-plant ; it was widespread in 1942, but rare in 1943. *M. solani* was not numerous at any centre, and the only notable observation of other species was the record of 51 examples of *Myzus ornatus*, Laing, per 100 leaves at Ambleside in August 1943. Parasitised Aphids were not numerous, but parasites probably contributed to the disappearance of *A. rhamni* in 1942. The predators, *Coccinella septempunctata*, L., and *Syrphus balteatus*, Deg., were common in 1943.

The conclusion drawn from the work is that, provided that districts are well isolated from sources of spring infestation, there appear to be large areas in the four countries well suited to the maintenance of healthy seed potatoes, particularly in Cumberland and Westmorland and the more hilly western parts of Northumberland and Durham. Northumberland is favoured by the comparative infrequency of good migration conditions in June, and the western counties are probably favoured by the comparatively high relative humidity of the hilly regions.

MASSEE (A. M.). **Notes on some interesting Insects observed in 1943.**—*31st Rep. E. Malling Res. Sta. 1943* pp. 58–65. East Malling, 1944.

Cydia pomonella, L., was a major pest of apple in Kent in 1943 ; adults of the overwintering generation emerged in late April and May, owing to the early season, and eggs were hatching during the first half of June. The larvae began to spin their cocoons in July, a few adults were observed at the end of August and a very small second generation was produced. The spray recommended is 2 lb. lead arsenate per 100 gals. water, applied when the first larvae have bored into the fruits, with the addition of 8 oz. nicotine to kill those just below the surface. *Anthonomus pomorum*, L., is of primary importance in Kent and Essex and is frequently controlled on bush and cordon apple trees by the removal of infested (capped) blossoms. The author suggests that these should be kept so that parasites that emerge from them can be liberated in the orchard. Apples that had been kept in a gas store since autumn were found in March to be tunnelled by larvae of *Hepialus humuli*, L., which had not been apparently affected by the conditions of storage ; the larvae normally feed on the roots of grasses, hops, herbaceous plants and strawberry, remaining in this stage for two years. Larvae of *Boarmia roboraria*, Schiff., which normally infests oak, fed on apple foliage in Kent in early March. Adults of *Hoplocampa testudinea*, Klug, appeared earlier than usual, and continued to oviposit on apple after petal-fall ; this sawfly is usually controlled by a nicotine spray applied when 80 per cent. of the petals have fallen, with the routine lime-sulphur spray, but a second application should be made some 7-10 days later in seasons in which some of the eggs are laid after petal-fall. Adults of *Otiorrhynchus singularis*, L., were observed feeding on the developing fruit buds of apple, just before the green cluster stage, in Kent, Essex and Somerset, causing much injury in some cases. These weevils sometimes damage newly grafted trees by gnawing the scions and destroying their buds.

defoliate young black-currant bushes in spring and girdle the shoots of raspberry, and the larvae destroy the tender roots of many cultivated fruit trees and bushes.

In the spring of 1943, *Nygmia phaeorrhoea*, Don., was sufficiently numerous in parts of Kent to cause considerable damage to apple and plum. The larvae hatch in August and hibernate in a common nest while still quite small; they become active in the following March and feed on the foliage until June, when they pupate. In 1943, they began feeding in spring before the foliage had expanded, and therefore attacked the buds, frequently denuding whole branches. *Paratetranychus pilosus*, C. & F. (*Oligonychus ulmi*, auct.) was extremely injurious in many apple and plum orchards in Kent and Essex, particularly in districts in which the rainfall was light and the trees were growing in an unhealthy state on gravelly formations. Trees that received one or more lime-sulphur sprays after petal-fall were much less infested later in the season than those that did not. *Cydia funebrana*, Treitschke, which occurs sporadically on plum, caused considerable damage in some parts of Kent and in the West Midlands. The larvae hatch at about mid-June from eggs laid at the base of the fruit stalk and burrow into the fruit towards the stone. The winter is passed by full-fed larvae in such places as cracks in the stems of the trees, and orchard hygiene should therefore be practised. An undetermined species of *Tetranychus*, provisionally referred to as *T. crataegi*, Hirst (*Amphitetranychus viennensis*, Zacher), was found on Aylesbury prune in Buckinghamshire in October; both summer and winter forms were congregated in large numbers under masses of webbing and beneath the bark.

Caliroa limacina, Retz., was locally plentiful on peach in Kent at the end of June, and caused considerable damage in some cases. It was also found on quince and *Cydonia japonica*, and was abundant on pear, on which the larvae were still feeding during the second week in October, but it did not attack cherries growing quite near. The larvae can be controlled by dusts or sprays of lead arsenate, derris or nicotine. Another sawfly, *Nematus ribesii*, Scop., was commoner than usual on gooseberry in Kent in 1942 and 1943, and was also observed on red currant. It has three or four generations a year, and can be controlled by sprays or dusts of lead arsenate, nicotine, derris or pyrethrum.

Peronea comariana, Zell., caused considerable damage to the foliage and fruits of strawberry in Cambridgeshire during the last week of May, and less serious damage in Worcestershire. By the end of May, many larvae of the first generation were full-grown and some had pupated in cocoons on the undersurfaces of the leaves; the pupal stage lasts 3–4 weeks. A high proportion of the larvae in Cambridgeshire were parasitised by the Encyrtid, *Copidosoma tortricis*, Wtstn. Some control of this Tortricid was obtained by means of a 4 per cent. nicotine dust applied when the larvae were first noticed. *Dysstroma* (*Cidaria*) *citrata immanata*, Haw., attacked the leaves of strawberry in Cambridgeshire, Kent and Worcestershire at the end of May; the usual food-plants of this Geometrid include sallow [*Salix caprea*], birch, bilberry [*Vaccinium myrtillus*] and wild strawberry. Several ground beetles, of which *Harpalus rufipes*, Deg. (*Ophonus pubescens*, Müll.), is the most important, feed on the ripening fruits of strawberry under certain conditions, and sometimes cause considerable damage. This type of injury is most prevalent in south-western England, but sometimes occurs in Kent, where most of the infested fields are adjacent to woods, which are probably the natural habitat of the beetles. In recent years, *Lygus pabulinus*, L., has become commoner on strawberry, particularly in Cambridgeshire, where it causes considerable injury and appears to pass its whole life-cycle on the plants, overwintering on them in the egg stage. In 1943, nymphs of this Capsid fed on the leaves throughout May, causing severe malformation. Nicotine dusts have not given satisfactory control, but it is thought that fumigation with vaporised nicotine when the nymphs are very young might prove effective. *Tarsonemus pallidus*, Banks,

is prevalent in strawberry-growing areas of Kent, Cambridgeshire and Worcestershire. In Kent, some serious infestations were observed in August, but the damage became more widespread by the end of September ; the mites cease to breed in autumn, and new leaves that develop then round the crowns of the plants are not infested. Some control is obtained by spraying with 2 per cent. lime-sulphur when the mites are emerging from hibernation, usually about the third week of March.

Calocoris fulvomaculatus, Deg., is less widespread on hops than it was twenty years ago, but it is still sufficiently numerous in many gardens, particularly in one district of Kent, to cause considerable damage to the growing bines. It usually occurs only where the pole-work method of growing hops is still practised, as the eggs are deposited in the poles and pass the winter there. They are laid in late July or August and begin to hatch in mid-May. This Capsid is also found on several bush fruits, particularly red currant. If control measures are necessary, a dust of 4 per cent. nicotine should be applied when hatching is complete. The prevalence of *Phorodon humuli*, Schr., on hops in Kent varied considerably in 1943 ; winged migrants were first seen on hops on 17th May, and large populations were present in many gardens during the latter part of May and in June. The Aphid was scarce in the Weald of Kent, however, and this may have been due partly to the mild winter of 1942–43, which was favourable to Coccinellids.

Petrobia lapidum, Hammer, caused considerable injury to young onion plants in Worcestershire by feeding on the growing points ; the plants eventually wilted and became silvery in colour. This Tetranychid is widely distributed in Britain, and is common among rocks, but it is unlikely to become a serious pest, particularly if onions are not grown on the same ground for two seasons in succession.

Massee (A. M.). **Further Notes on the Woolly Aphid Parasite** (*Aphelinus mali* **Hald.).**—*31st Rep. E. Malling Res. Sta. 1943* pp. 65–67, 5 refs. East Malling, 1944.

The author gives a brief account of attempts in 1924–38 to establish *Aphelinus mali*, Hald., at four places in Kent for the control of the woolly Aphid [*Eriosoma lanigerum*, Hsm.] on apple [*cf. R.A.E.*, A **21** 370 ; **22** 584 ; **23** 426], and states that although the parasite had apparently failed to establish itself in various orchards there it was found in 1942 to have become established in the Chelmsford district of Essex, where it had been liberated a few years earlier, and was rapidly spreading over a wide area of the county. Its progress was still more rapid in 1943, and it was then decided to make a further survey of all the centres in Kent in which releases had been made. This showed that the parasite was giving complete control and spreading in one district and was also abundant in two of the other three.

Although *A. mali* can withstand low temperatures without heavy mortality, the damp climate of England is considered unsuitable for it, and an attempt is being made to maintain it through the winter in cold or dry storage ; for this purpose, shoots bearing parasitised Aphids were cut in October and stored at 37°F. or in dry storage in a boarded loft ; a preliminary examination early in February showed that the parasite had survived four months of dry storage without loss.

Richards (O. W.). **The Two Strains of the Rice Weevil,** *Calandra oryzae* **(L.) (Coleopt., Curculionidae).**—*Trans. R. ent. Soc. Lond.* **94** pt. 2 pp. 187–200, 6 figs. London, 1945.

Individuals of *Calandra oryzae*, L., vary greatly in size, and very large ones are often found associated with maize and small ones with Plate wheat, but

preliminary experiments described in this paper showed that although the kind of grain (Plate wheat, English wheat and maize) had some effect on the size of the weevils, the principal cause of variation was the existence of two strains, one of which was about twice as heavy as the other. The strains were found to differ in that the large one had a shorter life-cycle at 25°C. [77°F.], a slower rate of sexual maturation, a higher rate of oviposition and a greater resistance to starvation ; also its larvae ejected much more frass. No other physiological characters were investigated. It was very difficult to cross the two strains, and the hybrids appeared to produce no viable offspring, but they are not regarded as separate species, since no non-overlapping morphological difference or combination of differences between them was found.

TREHAN (K. N.). **Some Observations on the Soil Fauna of Cotton Fields at Lyallpur.**—*Proc. Indian Acad. Sci.* Sect. B **21** no. 4 pp. 191–201, 3 figs., 13 refs. Bangalore, 1945.

An account is given of an investigation, begun in 1927 at Lyallpur, in the Punjab, on the soil fauna of cotton fields. Samples of soil were taken from the fields while they were under cotton and while they were fallow and washed in muslin bags under the tap or in a stream. The fields are described and the results are given in tables. The population was greatest in the top three inches of soil, and the proportion in this layer was greater when the fields were under cotton. Insects were the most numerous of the macro-organisms present, and Coleoptera and Diptera were the commonest insects. Nematodes were next in abundance.

LAL (K. B.) & AFZAL HUSAIN (M.). **Hairiness of Cotton Leaves and anti-Jassid Resistance.**—*Curr. Sci.* **14** no. 6 pp. 153–154, 4 refs. Bangalore, 1945.

It has been thought that varieties of cotton with hairy leaves were more resistant to *Empoasca devastans*, Dist., in India than smooth-leaved varieties, but the authors consider that hairiness is not in itself a factor of resistance, though it may possibly indicate the occurrence of such a factor. They have shown that the resistance of hairy varieties, is due, not to the inability of the Jassids to feed on them, but to their inability to oviposit in the leaf veins [*R.A.E.*, A **29** 517]. They conclude that the resistant character should therefore be sought in the veins and suggest that future research should aim at solving the question of measuring the toughness of leaf veins quickly and simply, if this is found to be the chief factor governing resistance.

KRISHNAMURTI (B.) & APPANNA (M.). **Influence of Mercury on Insect Eggs. Part II.**—*Curr. Sci.* **14** no. 7 pp. 168–170, 2 figs. Bangalore, 1945.

An account is given of further experiments in India on the effect of mercury vapour on the eggs of *Corcyra cephalonica*, Staint. [*cf. R.A.E.*, A **33** 164]. When eggs 16 hours old were exposed for 48 hours to a lethal dosage of mercury and dissected, it was found that the vapour had disintegrated the contents and prevented normal development. To determine the minimum lethal dose of mercury in a jar of 3,300 cc. capacity filled with grain, eggs were placed in the middle and at the bottom of the grain and the mercury on the top. The percentage mortalities were 0 for 30 and 40 mg. mercury, 82 for 50 mg. and 100 for 60 mg. or more.

In tests to determine the lethal dosages for larger volumes, the mercury was placed at the top and the eggs at the bottom of empty and grain-filled jars. In empty jars of 4,000, 6,600, 8,000 and 10,800 cc. capacity, complete mortality was given by 50, 60, 100 and 180 mg., respectively, and in those filled with grain, by 100, 120, 200 and 360 mg.

It was observed in both these experiments that some of the mercury had not vaporised at the end of 4 days (the period required for untreated eggs to hatch), and it was calculated that the actual (vaporised) minimum effective dosages had been 0·6, 0·8, 1·4, 1·6 and 2·4 mg., respectively, for grain-filled jars of the five sizes used, the figures for empty jars differing from these hardly at all, but when the mercury was applied at these dosages, the treatments were ineffective, probably because the requisite vapour pressure was not attained before the eggs hatched. The increases in both apparent and actual dosages were not proportionate to the increases in volume of space. In confirmatory tests, the actual minimum dosages of mercury were applied in grain-filled jars of the appropriate sizes, but the mercury was spread on copper foil to form an amalgam. It vaporised almost completely and gave complete mortality in each case.

Basu (A. C.). **Life-history and Bionomics of the Cauliflower Pest,** *Prodenia litura*, **F., in Bengal.**—*Sci. & Cult.* **10** no. 10 pp. 420–422, 2 figs., 6 refs. Calcutta, 1945.

Prodenia litura, F., is an important pest of cauliflowers in Bengal, and an account is given of observations on its life history and of the appearance of all stages. Pairing occurred 1–2 days after the adults emerged, and the females deposited up to 578 eggs in batches on the lower surface of the leaves.

The preoviposition period and the egg, larval and pupal stages lasted 2–4, 4, 18–20 and 9–10 days, respectively, and the adults survived for 10–24 days.

Lefèvre (P. C.). **Un nouveau parasite du haricot,** *Melanagromiza* (*Agromiza*) *phaseoli* **Coq., au Kivu.**—*Rev. Agron. colon.* **4** no. 2 pp. 1–6, 16 refs. Costermansville, 1944.

Agromyza (*Melanagromyza*) *phaseoli*, Coq., was found on beans (*Phaseolus vulgaris*) in the east of the Belgian Congo in May 1939, and was very injurious over most of Kivu and Ruanda-Urundi in July-September 1943. It attacks the plants at soil level and causes wilting of the first two leaves of young seedlings and scarring of the stems of older ones; secondary roots may be developed above the injury if suitable cultural methods are employed [*cf. R.A.E.*, A **28** 395]. The females deposit about 100 eggs in the course of about 16 days, beginning on the third day after emergence. Oviposition occurs during the hottest part of the day, and the eggs are laid in the first leaves as soon as they appear, in the tissues most exposed to the sun. The larvae mine in the leaves for a day or two and then burrow through the petioles to the stems, in which they live at the level of the soil. They pupate at the same level or a little higher. Severely infested plants contained 8–16 pupae. In older plants, some larvae may live in the nodes of stems or in the petioles as well as at the base of the stem. The life-cycle lasted 45–51 days at Kivu, so that there may be 7–8 generations in the year. Pupae were frequently parasitised by two Chalcidoids.

Suggested control measures [*cf. loc. cit.*] include sowing at the beginning of the rainy seasons, when the plants can outgrow attack rapidly, choosing suitable soils, and earthing up the plants when they have developed four leaves. Species of *Crotalaria*, which are alternative food-plants, should be surveyed for infestation, and severely infested bean plants should be burnt at once and the remainder after harvest, together with self-sown plants.

Vrydagh (J. M.). **Le thrips des serres** (*Heliothrips haemorrhoidalis* **Bouché**) **nuisible au** *Cinchona ledgeriana* **en pépinière.**—*Bull. agric. Congo belge* **35** no. 1–4 pp. 80–84, 1 fig., 1 ref. Léopoldville, 1944.

Heliothrips haemorrhoidalis, Bch., was observed damaging *Cinchona calisaya* var. *ledgeriana* in nursery beds in the Belgian Congo, in 1942. This

introduced thrips, the adult female of which is described, had been recorded on cacao in the Colony in 1925, and is probably more widely distributed there than is apparent from the records. The nymphs feed on the lower surface of the leaves of *Cinchona* and cause the appearance of discoloured areas. Infested leaves wither and the plant quickly dies. The nymphs pupate in the soil, and the females, which reproduce parthenogenetically, oviposit under the epidermis of the leaves. Nurseries of *Cinchona* provide favourable conditions for development, since the humidity is kept high, and the temperature, which in sunny weather may reach 26°C. [78·8°F.], the optimum for *H. haemorrhoidalis* [*cf. R.A.E.*, A **23** 501], is fairly constant. Sprays containing 1·5 per cent. nicotine give complete mortality of the thrips, but as nicotine is difficult to procure locally, experiments were made with sprays prepared by soaking partly dried and finely chopped native tobacco in 1 per cent. soap solution for 24 hours and filtering the liquid. Sprays in which the tobacco was used at rates of $2\frac{1}{4}$, $4\frac{1}{2}$ and $6\frac{3}{4}$ lb. per 10 gals. all gave complete mortality, but three applications at weekly intervals are necessary to destroy the nymphs that hatch from the eggs, which are not affected.

STEYAERT (R. L.). **Situation phytosanitaire des agrumes au Bas-Congo.**—*Bull. agric. Congo belge* **35** no. 1–4 pp. 103–126, 1 fig., 10 refs. Léopoldville, 1944.

The principal insect pest of *Citrus* in the Lower Congo is *Lepidosaphes beckii*, Newm., but *Icerya purchasi*, Mask., is of potential importance. Both these Coccids are described, and general information is given on their bionomics, economic importance and control in other countries. In the Lower Congo, damage by *L. beckii* is usually most severe in dry districts, but may be greatly reduced by irrigation and cultural measures. A humid climate favours the development of the entomogenous fungi, *Tetracrium rectisporum* and *Tubercularia coccicola*, which are the conidial forms of *Podonectria coccicola* and *Nectria tuberculariae*, respectively. Both these fungi occur on *L. beckii* in the Lower Congo, where *T. coccicola* is the more abundant, but their perfect forms have not been observed there and they do not give effective control; preliminary observations indicated that they attack only the adults. At Bambusa, on the other hand, where *T. coccicola* does not occur, *Tetracrium rectisporum* is highly effective and its perfect form (*P. coccicola*) has been observed at the beginning of the principal rains, in August. *Tubercularia coccicola* has been artificially distributed at the Experiment Station at M'Vuazi by spraying with water in which leaves and branches bearing infested Coccids had been washed. This fungus attacked up to 70 per cent. of the adults of *L. beckii* in one area.

Fumigation of the trees with hydrocyanic acid gas is impracticable throughout much of the Belgian Congo, owing to the heavy dews, and, as the extensive use of mineral-oil sprays would necessitate importing large quantities of oil, experiments were carried out at M'Vuazi in 1942 to determine whether they could be replaced by available vegetable oils. Palm oil proved unsatisfactory for this purpose, owing to the formation of precipitates when oleic acid was added for emulsification, but cottonseed oil gave more promising results. A spray of cottonseed oil, oleic acid, ammonia and water (3 : 1·5 : 1 : 6) diluted to contain 2 per cent. oil and applied to grapefruit at the rate of 4·4 gals. per tree on 12th October gave 60 per cent. mortality within a week, while a proprietary mineral-oil spray at comparable concentration, with the addition of Bordeaux mixture containing zinc sulphate as well as copper sulphate, applied on 10th September at the rate of 2·2 gals. per tree, gave 63 per cent. mortality. It is thought that the inclusion of Bordeaux mixture would increase the effectiveness of the cottonseed-oil spray. The latter spray was ineffective when used at the rate of 3·3 gals. per tree. The development of *L. beckii* probably requires about $2\frac{1}{2}$ months during the rainy season, and two or three applications during this period and one or two during the dry season are therefore recommended.

I. purchasi appears to have been recently introduced into the lower Congo, with *Citrus* from the Mediterranean region ; the author observed it only at M'Vuazi, where it chiefly attacked nursery stock and did not seem to be of much importance. He suggests that the predacious Coccinellid, *Rodolia* (*Novius*) *cardinalis*, Muls., should be introduced for its control and that nursery stock sent out from the Station should first be fumigated with hydrocyanic acid gas to prevent its spread.

Citrus is also attacked by undetermined Aphids, which appear to be controlled by a fungus tentatively determined as *Cladosporium* sp.

STEYAERT (R. L.). **Situation phytosanitaire des cultures au Bas-Congo (à l'exclusion du palmier à huile et des agrumes).**—*Bull. agric. Congo belge* **35** no. 1–4 pp. 127–146, 2 figs., 10 refs. Léopoldville, 1944.

Of the pests that attack cacao in the Lower Congo [*cf.* next abstract] *Sahlbergella singularis*, Hagl., is the most important, but severe damage by the Lamiids, *Tragocephala guerini*, White (*anselli*, Bates) and *T. pulchra*, Jord., and some damage by *T. maynei*, Gahan, has occurred in certain districts. The larvae bore in the young branches and suckers [*cf. R.A.E.*, A **14** 10], and infested trees can be distinguished by the wilting of the leaves and the series of holes along the branches, and in large branches, by the frass ejected from the galleries. The larvae can be killed by inserting a wire into the gallery, by plugging the gallery with cotton-wool soaked in carbon bisulphide, or by placing paradichlorbenzene in it and sealing the entrance with clay. Thrips, which are very common, but may not cause important damage, can be controlled by a spray made by soaking chopped tobacco leaves in a solution of soap and sodium carbonate.

Cosmopolites sordidus, Germ., is widespread in banana plantations in the Lower Congo. At M'Vuazi, the use of traps consisting of sections of banana stem and the maintenance of vigorous growth has considerably reduced loss ; the traps need to be replaced every 10–15 days. In preparing stock for new plantations, care should be taken to select uninfested suckers ; they should be removed from the plantation before nightfall to premises from which the adults can be excluded, plunged into water for 48 hours, and shipped immediately afterwards. Immersing suckers in water for 24 hours to free them from infestation is not always successful, owing to the development of air pockets in the galleries. These measures are not considered sufficient if plantations are to be established in uninfested areas.

Pseudococcus brevipes, Ckll., is widespread on pineapple at M'Vuazi [*cf.* **30** 31], and a virus disease of potato (*Marmor cucumeris* var. *upsilon* of Holmes), which is transmitted by Aphids, occurs in the Colony, but is not common.

LIÉGEOIS (P.). **La culture du cacaoyer au Congo Belge.**—*Bull. agric. Congo belge* **35** no. 1–4 pp. 147–173, 9 figs., 5 refs. Léopoldville, 1944.

A section of this paper (pp. 164–170) comprises notes on the habits of insect pests of cacao in the Belgian Congo, with recommendations for their control and descriptions of the more important species. One of the most injurious is *Pseudaonidia trilobitiformis*, Green, which occurs on the veins of the leaves, especially the young ones, and on the fruit stalks ; both leaves and fruits are killed by it. Its food-plants in the Lower Congo include *Citrus*, *Aleurites*, *Ficus* and *Millettia*, and it was found on young plants of *Passiflora* from Leopoldville. Other Coccids are *Aspidiotus gracilis*, Balachowsky, which is abundant on the lower surface of the leaves, especially on unshaded trees, and causes them to fall prematurely, weakening old trees and retarding the growth of young ones ; *Stictococcus formicarius*, Newst., which is sometimes numerous

on the pods and is tended by the ant, *Oecophylla smaragdina*, F.; *Ferrisia virgata*, Ckll., which attacks the terminal shoots of young trees; and *Icerya tremae*, Vayss., which occurs on the lower surface of the leaves, but is rare. *Sahlbergella singularis*, Hagl., attacks the pods, branches and trunks and is a very serious pest; *Helopeltis bergrothi*, Reut., is of less importance. A Psyllid of the genus *Phacopteron* occurs on the shoots and lower surfaces of the young leaves, causing the mid-ribs of the latter to shrink and the surface to take on a blistered appearance, and sometimes on the buds and flowers, arresting their development. Injury to the foliage appears chiefly at the beginning of the rainy season and on heavily shaded trees. *Selenothrips rubrocinctus*, Giard, infests the leaves of unshaded trees, which it sometimes kills.

The Lamiids that attack cacao belong to the genera *Glenea*, *Phosphorus* and *Tragocephala*; *T. guerini* var. *buqueti*, Thoms., causes severe damage to trees 2–3 years of age by killing the terminal bud and boring in the trunk [*cf. R.A.E.*, A **14** 10]. The Cossid, *Eulophonotus myrmeleon*, Feld., oviposits in cracks in the bark. On hatching, the larva bores into the wood and then constructs a vertical gallery; several such galleries are constructed before pupation, which occurs at the bottom of the last one. The larvae are parasitised by a Tachinid, several examples of which develop in a single host.

BREDO (H. J.). **Le problème du criquet pèlerin** (*Schistocerca gregaria* **Forsk.**) **au Congo Belge.**—*Bull. agric. Congo belge* **35** no. 1–4 pp. 174–180, 15 refs. Léopoldville, 1944.

As the breeding grounds of *Schistocerca gregaria*, Forsk., are situated in desert areas, it was thought improbable that it would enter the Belgian Congo, where the climate is humid. In 1930, however, two swarms were recorded in Ituri and it is possible that records of swarms of *Locusta migratoria migratorioides*, R. & F., flying over the northern part of the Colony also refer to *S. gregaria*. The catalogue of the Musée du Congo Belge contains records for this species from Ituri in 1929 and 1930, and from Ruanda in 1932, and a flying swarm observed in Ituri in 1928 is believed to be the one recorded in 1929. The movements of swarms in neighbouring territories in 1929–30 are discussed with reference to the records for the Belgian Congo, and it is concluded that the latter is liable to invasion from Ubangi-Shari (French Equatorial Africa) [*R.A.E.*, A **19** 683], Uganda and Tanganyika. The record from Ruanda in 1932 is inexplicable, since no swarms were reported in that part of Africa from June 1930 until 1942.

The swarms caused considerable damage while crossing the open plains of the Colony, but no breeding took place; it is possible, however, that in regions such as Ituri and Ruanda, where there are two rainy seasons during the year, two generations might develop annually from eggs laid at the beginning of the rains. Lists, based on records in a paper already noticed [**21** 562], are given of the plants of importance in the Belgian Congo that are liable to be severely or occasionally attacked by *S. gregaria*, and the control measures usually recommended against the hoppers and the swarms are summarised.

VRYDAGH (J. M.). **Note au sujet de la région cotonnière de Mahagi et essai d'introduction dans l'Uele du parasite du ver rose de la capsule, le** *Microbracon kirkpatricki*, **Wilk.**—*Bull. agric. Congo belge* **35** no. 1–4 pp. 181–190, 1 map. Léopoldville, 1944.

In the first part of this paper a short account is given of the topography, vegetation, climate and soil of the cotton-growing area of Mahagi, near Lake Albert, in the Belgian Congo, together with an annotated list of the insects

recorded there on cotton. Of the three species of *Dysdercus* present, *D. fasciatus*, Sign., is the commonest, and *D. superstitiosus*, F., and *D. nigrofasciatus*, Stål, are in general rare. The period required for development of *D. fasciatus* at a mean temperature of 21·3°C. [70°F.] averaged 46·3 days, whereas at Bambesa, in the Uele region, the averages for *D. superstitiosus* [*R.A.E.*, A **31** 297], *D. nigrofasciatus* and *D. melanoderes*, Karsch, were 32, 34 and 36 days at about 25°C. [77°F.]. Six fertilised females of *D. fasciatus* each oviposited four times in 25 days, laying an average of about 100 eggs on each occasion ; at Bambesa, the average numbers of eggs deposited at a time by females of the other three species were 84, 111 and 94, respectively. No parasites of *Dysdercus* were observed at Mahagi, but the predacious Reduviid, *Phonoctonus principalis*, Gerst., was fairly common. *Platyedra gossypiella*, Saund., is present throughout the area, but is commoner by the shores of the lake than on the plateaux ; no double seeds were found at the ginning factory, and diapause probably does not occur in this area. The other insects recorded are *Zonocerus variegatus*, L., *Calidea dregii*, Germ., *Helopeltis* sp., *Earias insulana*, Boisd., *E. biplaga*, Wlk., which is rare, *Sylepta derogata*, F., which is abundant at one place, but was not found elsewhere, and Jassids, which are not of great importance.

The second part of the paper is an account of an attempt to introduce *Bracon* (*Microbracon*) *kirkpatricki*, Wlkn., which was found parasitising *P. gossypiella* in Mahagi in February 1942, into Uele. The parasites were reared in a field laboratory during December 1942, and 300 that were despatched at the end of the month to Bambesa by lorry arrived in good condition in two days. They were caged with larvae of *P. gossypiella*, but only seven offspring were produced and these died without breeding. Another attempt was less successful ; 150 adults reached Bambesa alive, but died in four days without producing offspring.

LEFÈVRE (P. C.). **Note sur quelques insectes parasites de** *Manihot utilissima* **Polh. dans la région de Kasenyi (Lac Albert).**—*Bull. agric. Congo belge* **35** no. 1–4 pp. 191–200, 9 refs. Léopoldville, 1944. Repr. in *Rev. Agron. colon.* **3** no. 1 pp. 13–22. Costermansville, 1944.

Notes are given on insects found on cassava during a survey in 1939 of a plain situated at an altitude of about 2,000 ft. near Lake Albert, in the Belgian Congo. Climatic data for the area are shown in a table. Descriptions of almost all the species mentioned are included, and their distribution in Africa is summarised from the literature.

The most harmful was the Bostrychid, *Heterobostrychus brunneus*, Murray, which enters the stem through a node and frequently bores completely through the wood. Other insects found boring in the stems were *Sinoxylon brazzai*, Lesne, *Calandra oryzae*, L., *Stephanoderes* sp., *Eldana saccharina*, Wlk., *Mesotrichia* (*Xylocopa*) *senior*, Vachal, and *Ceratina* sp. *S. brazzai*, which was common, generally enters the stem through a node ; 19 of these Bostrychids were present in a piece of stem about 2½ ins. long and rather more than ½ in. in diameter at the base. *C. oryzae* enters the stem at any height from the ground, and the entrance hole is filled with finely powdered wood. The eggs of *E. saccharina* are laid on twigs, leaves, or even on empty pupal cases, the average per female being 180, and the larvae feed and pupate within the stems. In the laboratory, it was observed that stems cut by the larvae of this Pyralid were often joined together by threads that they secreted ; the egg, larval and pupal stages lasted 8, 34–35 and 10 days, respectively. The female of *M. senior* constructs an almost vertical tube in the stem in which to oviposit. One egg is deposited at the bottom, with pollen or honey as food for the developing larva, the cell is covered in, and others are made along the tube. The larvae develop in 16 days.

Eggs of *Anaphaeis aurota*, F. (*Pieris mesentina*, Cram.) are laid on the leaves in masses of over a hundred. As many as 128 larvae were counted on a single plant; some that hatched on 15th May pupated on 26th. Large numbers of adults were observed in flight at the beginning of April, especially following light rainfall at night; after rainfall of approximately 2½ ins. lasting only a few hours, most had disappeared. The larvae were also observed feeding on *Maerua* sp. About 20 per cent. of the pupae were parasitised by *Brachymeria* sp. Only one parasite developed in each pupa, and the adults emerged 3–4 days before the normal date of emergence of the host. *Sturmia* sp. parasitised 8–9 per cent. of the pupae of *A. aurota*. The larva of this Tachinid leaves the host pupa 5–6 days after it is formed and pupates in a few hours. Emergence took place after 10–11 days when the minimum and maximum temperatures were 29·5 and 27°C. [85·1 and 80·6°F.], and after 12–13 days when they were 26 and 24·5°C. [78·8 and 76·1°F.]. Other insects observed on cassava were the Agaristid, *Aegocera rectilinea*, Boisd., the larvae of which feed on the leaves, and an undetermined Coccid, which infests the stem. The latter are preyed upon by *Chilocorus distigma*, Klug.

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Essig (E. O.) & Hoskins (W. M.). **Insects and other Pests attacking agricultural Crops** [in California].—*Circ. Calif. agric. Ext. Serv.* no. 87 (revd.), 197 pp., 182 figs., refs. Berkeley, Calif., 1944. [*Cf. R.A.E.*, A **23** 108.]

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NOTICES

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